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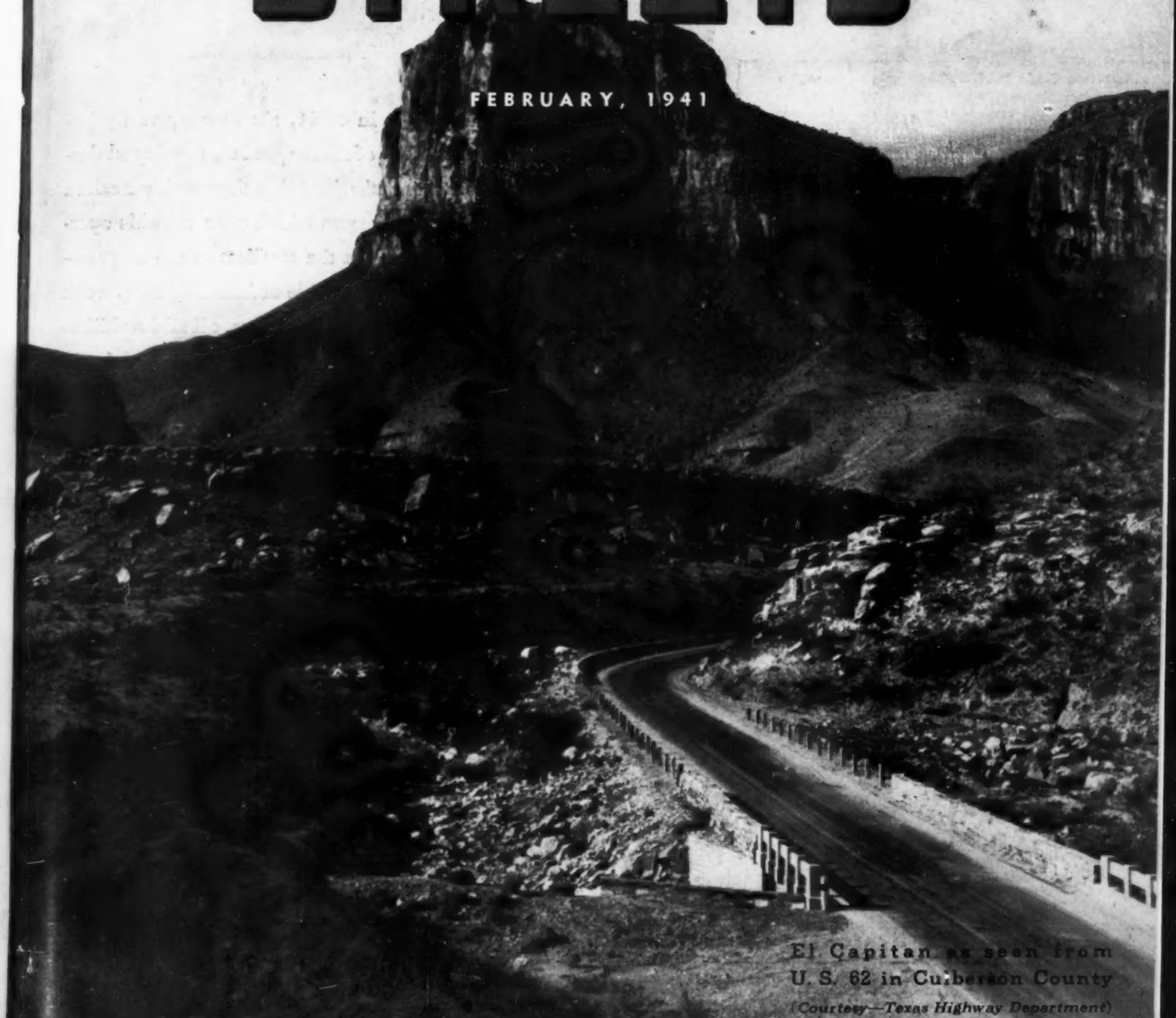

El Capitan as seen from U. S. 62 in Culberson County
(Courtesy—Texas Highway Department)

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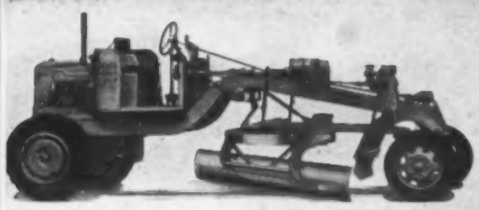
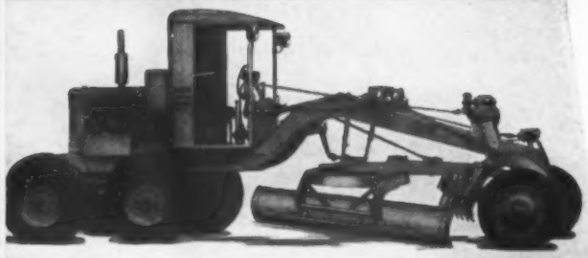
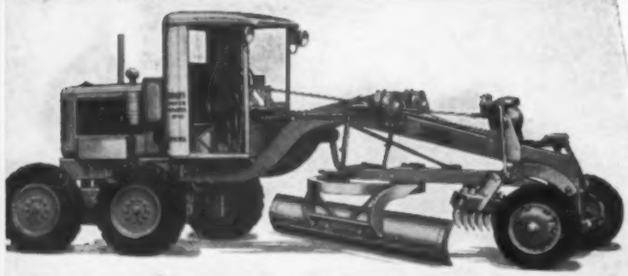
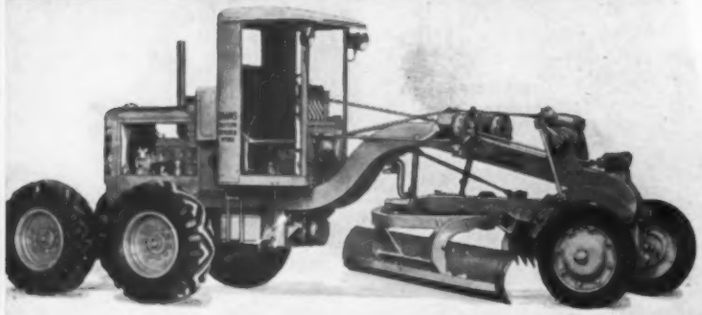
USING ENGINEERING FORMULAS
BY STEWART MITCHELL









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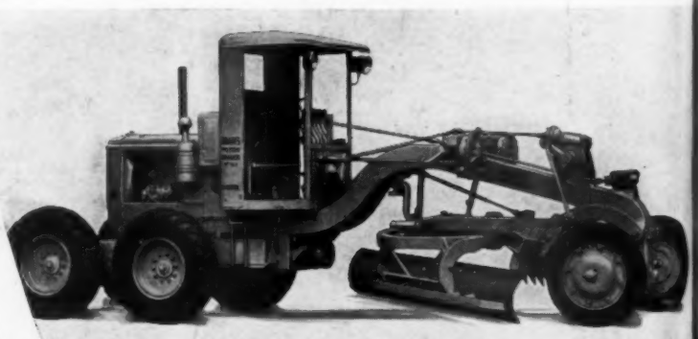

ADAMS MOTOR GRADERS

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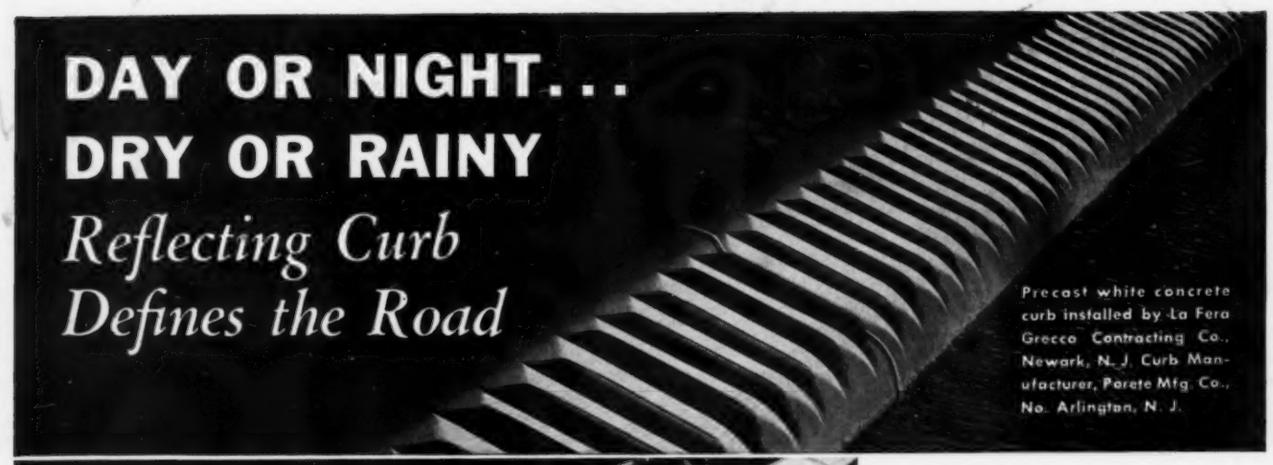
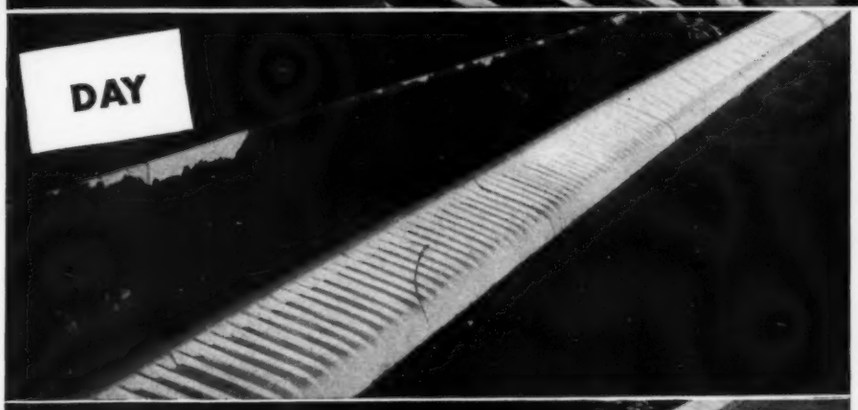
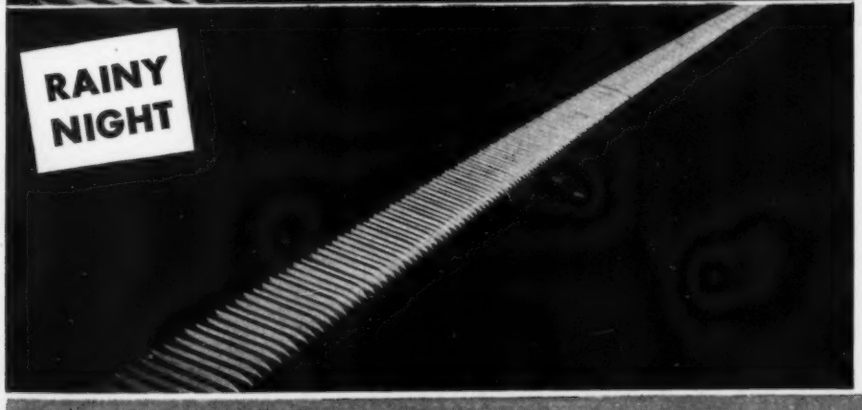
Reflecting Curb Defines the Road



Precast white concrete curb installed by La Fera Grecco Contracting Co., Newark, N. J. Curb Manufacturer, Porete Mfg. Co., No. Arlington, N. J.





This White Concrete Reflecting Curb increases visibility to an amazing degree. It dominates the road by day, adequately defining the center island, and is even more visible at night. The curb shown is on the approach to Passaic River Bridge, Route 25, Kearny, N. J.

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ROADS and STREETS

Vol. 84, No. 2 February, 1941

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LET'S LOOK AT WHAT WE'RE DOING AND WHY

Assumptions Made for Deducing Engineering Formulas Should Always be Investigated

By STEWART MITCHELL

Senior Bridge Engineer, Division of Highways, California Department of Public Works

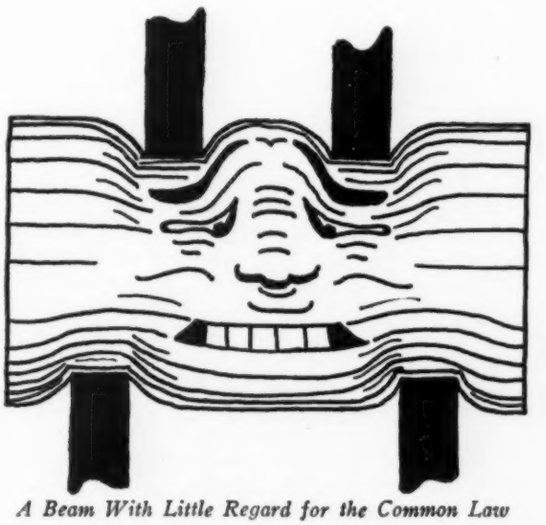
FOR several years my work has required me to devote a large part of my time to a consideration of the service records of our state highway bridges. The data collected have, I believe, made it possible to present some facts and ideas connected with the strength and performance of structures, a subject not commonly discussed in current engineering literature.

The details of important structural failures are usually published, but when structures continue to serve their purpose without having attention attracted to them by some major failure it is hard to find out how efficiently they do serve the purpose for which they were built.

It is hoped that some highlights on this question of structural efficiency, as exemplified by our experience with highway bridges, will be of interest.

Because of certain laws, more or less peculiar to California, its highway officials are forced to take a responsible interest in the safety and carrying capacity of bridges. The Motor Vehicle Code of the state says that whenever in the judgment of the Department of Public Works, any bridge or other structure, over which it has jurisdiction, will not "sustain with safety to itself" the maximum loads permitted under the code, that department shall determine what load it can safely sustain. It is a very definite instruction, but its proper administration opens a veritable Pandora's Box of engineering troubles that we are trying to solve. It can be seen that if it is not given proper consideration it will result in either a hazard to traffic on the one hand, or an unnecessary hardship to the hauling of commodities on the other.

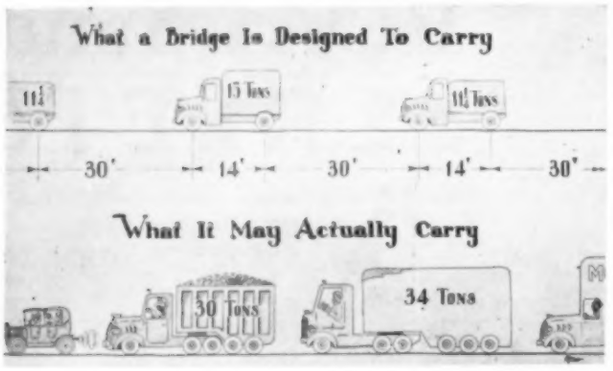
A Law Abiding Beam Which Knows That— $f = \frac{Mc}{I}$



A Beam With Little Regard for the Common Law

First Record of All State Highway Bridges in 1928

Prior to 1925, this state only maintained such sections of the highways as had been built under its own supervision—in accordance with proper specifications and inspection,—and a few county built bridges accepted as being built to the same standards as its own. In January, 1926, in accordance with a new law, the state took over for maintenance the best traversible road along each state highway route. With these roads it had to take over for maintenance, bridges of every conceivable condition and standard of construction. A year or so thereafter a field inspection was made of every bridge on the high-



It All Depends Upon the Point of View

way system, with sufficient detail to obtain a general idea of its condition and strength, and to pick out those structures most in need of further attention. This work, completed in 1928, resulted in the first record of all bridges on the state highways and their location that was ever made.

At the time this was done, heavy commercial vehicles had only started on the way to their present development—both as to number and concentrations of weight. The mileage of state highways was then less than half of what it is now and the gas tax funds available for construction work were larger. (At that time the cities did not get ½c from the gas tax.) Furthermore, ideas on how to proceed in the matter of posting bridges for the safe load were somewhat hazy and the responsibility that is placed on highway officials not fully realized. Because of these conditions, and the press of other work considered more important at that time, the investigation of bridges was limited to obtaining data for the most needed repair and reconstruction work.

Notable improvement had been made in the condition of bridges on the state highways when, in 1931 and chiefly in 1933, additional county roads were taken into the system which practically doubled the mileage up to that time. These added roads were, to a large extent, secondary in importance and, consequently, the bridges on them were of lower standard and in poorer condition than those on most of the roads of the original system. The effect of the increasing weight concentrations on trucks, and their number, was being felt. Several cases where light steel spans completely collapsed primarily because of careless operation of vehicles, occurred, fortunately without loss of life or serious injury. These occurrences brought home the serious possibilities of such an accident resulting fatally, and particularly if it was of a spectacular nature.

Duties of Special Section of Bridge Department

It was then realized that a larger and more completely equipped organization was necessary to properly take care of the situation. The duties of the section of the bridge department assigned to this work may be of interest as showing the nature of the information we obtain:

1. Making periodical field inspections and recording pertinent data in connection with all state highway bridges, and other special bridges when requested.
2. Preparing plans and making recommendations for the needed repairs to the bridges, or for strengthening them when this is economical or practicable.
3. Determining the safe load that can be allowed on every bridge not able to carry the legal loads.
4. Carrying on research work in connection with proper determination of the safe load on structures, economic methods of maintenance and the improvement of future bridge design.
5. Doing all statistical work and making technical studies connected (sometimes rather remotely) with bridge design, construction or maintenance, that is requested of it.

Planning and making repairs or improvements to existing bridges, in an efficient manner, is an important and interesting subject by itself. This article will be confined, however, to a comparison of the actual behaviour of structural members with that assumed or expected in designing them. The subject may be generally covered by seeking the answer to such questions as:

1. Do actual evidences of structural strength check the design calculations and, as a corollary, do structural members actually function in the manner expected by the designer?
2. Are the actual loadings and other forces to which a bridge is subjected analogous to those assumed in designing?
3. How does the service life and amount of maintenance compare with what we are accustomed to expect under different conditions of service?

That Inborn Reverence for Precedent

Persons who have not been faced with the problem of determining the actual load a structure will sustain, are likely to take it for granted that the actual strength of its members is directly in proportion to that found by application of the commonly accepted design rules and formulas. Also, their inspection of structures in use is usually confined to looking for failures or signs of weakness which are the result of faulty materials or details of construction. They seldom see or have a chance to find out if some parts are too strong, or, at least, if they are relatively much stronger than others, which means that either the stronger ones are too strong or the weaker ones too weak. This is important, as it involves the question of getting the same service for less cost, or, perhaps, a little less service for a much lower cost on the one hand, and the stability of the structure on the other.

Those who have been faced with the problem of finding the maximum load a structure will safely carry, soon discover that the rules and formulas that are commonly used to check the stresses when designing a new bridge, have many limitations when used indiscriminately for the purpose of determining the actual strength of its members. If this fact is not understood, the conclusions reached are quite likely to be absurd in the light of actual experience.

After the truth dawns upon us it seems rather incomprehensible that this was not apparent at the start, but it can probably be attributed to ingrained habits of thought, and an engineer's inborn reverence for precedent.

That Unholy Reverence for Traditionally Accepted Formulas

Like doctors, we engineers try to give outsiders the impression that our work is based on an exact science and that we know just exactly what we are doing all the time. Apparently we have acted that way for so long that we have come to believe it ourselves. (Of course, this refers only to those of us engaged in structural work. Any apparent similarity to other engineers, alive or dead, is purely coincidental.) Many of our so-called "fundamental formulas" or criteria for determining the stress in structural parts have been in use for so long

a time that their origin, and the assumptions made in deriving them, have been forgotten. We are accustomed to thinking of them as axioms in any man's language.

Our unholy reverence for traditionally accepted formulas and set rules of procedure, can probably be traced to our school training. Most of us dozed contentedly through our introduction to the laws of physics and the principles of mechanics. When called upon later to explain or work out problems we found that the application of some formula given in our text book gave the right answer—at least an answer that satisfied the professor. In order to get by we continued through school looking for the right formula, or rule, in the right book until it became a habit, and we came out of college with the feeling that any engineering problem could be solved if the right rule in the right book could be found. (It wasn't until I afterward met some of the men who wrote the books and realized they were human beings like myself that I began to wake up.)

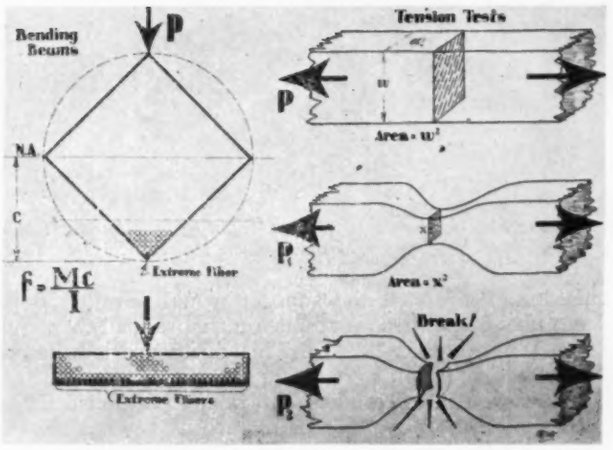
At any rate, we have used a set procedure so long—with a considerable degree of success within the field it was intended for—that we can't help feeling somewhat surprised when results obtained through its use do not check with actual experience. When this happens there is a tendency to stretch a point in order to make the results compatible with the traditional theory.

Several years ago, an arch bridge had to be abandoned and it was decided to test it to destruction. It was found impracticable to pile enough load on it to break it down, it was bombed without serious damage and finally drilled and torn to pieces with explosives. As I recall, from this proceeding came the conclusion that, if the stiffness of the arch superstructure was taken into account, the arch acted just about as anticipated by the design theories. If this is so it revises my idea of what a designer thinks of when planning an arch bridge.

Consider the Ordinary Beam Formula

Let us take a moment to look into the difference between true physical or mechanical principles and the criteria we use to design structural parts. Take the ordinary beam formula, one of the so-called fundamental formulas used by the structural engineer, and one that is familiar to all engineers if only from the memory of their school texts. To many it seems as fundamental as the law of gravity and as universally applicable. In the first place, it is not even theoretically correct if the beam is very short in comparison to its depth, but let us confine ourselves to long slender beams where it comes fairly close to being correct. Simple geometry, and the principle of the lever tell us how much the top or bottom fibers will stretch under a given load and assuming the material to be elastic (which means that stress is proportional to the amount of stretch), we can compute the stress in these outer fibers.

Now, in order to determine the maximum load a beam will support, it is customary to say that the stress in the outer fiber must not exceed the elastic limit, or, perhaps, the yield point. What is meant by this? We put a steel bar in a testing machine, run the machine at a certain rate, and when the pull of the machine gets out of proportion to the stretch of the bar, or when the bar will continue to stretch without additional pull, we read the load on the machine and divide it by the original area of the bar. As the bar stretches the area gets smaller—its cross section is reduced—but we arbitrarily use the original section and call the answer arrived at, the elastic limit or the yield as the case may be. It is not very evident why the figures so obtained should be the computed stress in a fiber at its elastic limit but let us assume that



On the Right—An Assumption We Use in Steel Design is Based on the Tension Test. We Divide P_1 by X^2 and Use the Result as Unit Stress for Design Where the Cross Sectional Area is w^2. P_2 Is Considerably Greater Than P_1

On the Left—A Case Where, Mathematically Speaking, a Greater Load, P_1 Can Be Carried if a Sliver Is Removed From Top and Bottom of Beam

the difference is not great. The point to be made is that this fundamental formula is largely empirical and therefore, must be tested before it can be accepted as true in all cases.

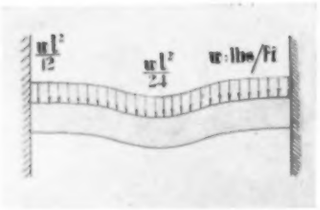
When the Formula Is Unable to Tell the Difference

Furthermore, the common assumption that exceeding the elastic limit of the outer fibres means putting a permanent bend in the beam is not correct. Take the classic example of the round or diamond-shaped beam section. It can be proved by mathematics on the basis of stress in the outer fiber, that a heavier load can be carried if we cut a sliver off the top and the bottom of the beam. While this deduction is mathematically accurate, common sense tells us that it is a bunch of horsefeathers. Look at it this way: if the outer fibers are stretched a bit and the load is then taken off, the beam will go back to about its original shape because of the pull of the other fibers. In doing so it will put compression in the lower fibers which are permanently elongated. When the load is applied again we will have first a decrease in the compressive stress until it is all gone, then tension will occur but it will not reach the elastic limit this time. You see the formula is unable to tell the difference between compression coming out and tension going into a fiber.

The load that an ordinary beam will carry, before it is permanently kinked may be 50 per cent more than that which theoretically stresses the outer fibers to their elastic limit. It depends, of course, on the cross section—the difference is large in the case of the diamond shaped section and much smaller in the case of a very shallow beam.

Let us now go a step further. Take the case of a fixed end beam under a uniform load. Applying the beam formula, the computed stress in the outer fibers at the supports reaches a critical figure first. Let these fibers stretch beyond the elastic limit so other parts of the beam take more of the load, then remove the load. As before, the stretched fibers are pulled back and compressed. The next time the load is applied, the action of the beam up to the point where the fibers at the center reach the so-called elastic limit will be quite in accordance with the theory of elasticity.

The load that the beam may carry by this assumption is 33 per cent greater than the usual limitation as to



Common Practice Formulas Shown. Eighty-Three Per Cent More Load May Be Carried Than Common Practice Says Is Safe

maximum stress at the support would permit. 50 per cent plus 33 per cent is 83 per cent more load than common practice says is safe. This difference is what we engineers refer to as approximately correct.

Now just one step more—in order to demonstrate another point. Suppose this load which we see has stressed some of the fibers beyond the elastic limit, is applied alternately to opposite sides of the beams. In this case the fibers will be continuously stretched, first on one side and then on the other and will ultimately break, as does the lid of a tin can when you bend it back and forth. Thus, if we are to obtain the benefit of using higher allowable stresses we must pay more than ordinary attention to the possibility of reversal of stress .More economic design practice therefore means more care and expense in designing, but it seems that it is hard to find substitutes for brain work and the assumption of responsibilities if progress is to be made.

Reasons Why Formulas Don't Always Give True Load Carrying Capacity

One of the more obvious reasons why the formulas used to compute stresses in designing do not give the true load carrying capacity under all conditions, is that simplified practices have been adopted which were never intended for use outside of the common restrictions put on size and shape of members, grade of materials and methods of fabrication. Many existing structures do not conform to these restrictions.

Another reason is that since new structures are expected to serve for a considerable time under conditions that can only be roughly estimated, the extra labor of using more rigorous methods of analysis is not justified —provided the results obtained are on the safe side.

Heavy equipment used for fire fighting damaged a light steel truss span and on investigation it was found that only the timber stringers of the floor were broken, no signs of strain in the steel members could be observed. The stringers had been considered safe for legal loads but the floor beams had been considered weak. It was figured that under the load that did the damage, the stress in the outer fibers as it is commonly figured was about 48,000 lb. per square inch. Yet no bending could be observed. Floor beams are stronger than figures show because of the practice of neglecting the stiffness of the end connections, the lateral support of stringers resting on them, etc.

It is common to find trusses with no tensile stress in the lower chord eye-bars because of no room for expansion at the end. They apparently act as arches, and apparently with success, although the idea is so foreign to our idea of how a decent truss should conduct itself that we can't rest easy until proper provision for expansion is restored. An inspection of a light steel swing span at rest showed one of the pins at the end joint part way out of its hole. The engineer while waiting for tools to force it back into place took hold of it and was surprised to find he could pull it all the way out with ease and without any ill effects on the span. I don't think it was designed that way.

Concrete bridges are the most unpredictable of the lot. Particularly those we design as simple beam spans, and then tie all the members together so they cannot possibly act the way they are designed. Rigid frame design is not a new type of structure but rather a rational design for the type that we have been actually building.

Results too much on the safe side indicate an economic waste, although this is not always serious. It is customary to figure the strength of a pin in a steel truss by applying the beam formula in the manner we have already discussed. A pin is in the category of a very short and relatively deep beam, in which case the actual strength in bending is much greater than the formula indicates. Also, no pin has ever been found bent in our experience, even though many of them in actual use figure to be overstressed beyond the breaking point on this basis. However, the somewhat larger pin which it calls for involves only a nominal increase in cost as compared to the total cost of the truss, and it has other perhaps rather intangible advantages. The unit bearing of the members on the pin will be reduced and this should aid in getting better pin action, which is a myth in many existing structures.

How Structural Design Can Be Simplified

Structural design can be simplified in two ways. Formulas may be used, within a limited range, that will give results reasonably close to those obtained by the use of more accurate mathematical analysis. Or, factors may be omitted which investigation has shown are of minor importance in ordinary design practice. When structures whose physical constants are considerably outside of the ordinary are to be designed, this practice should not be trusted. As example of the serious results that may follow the failure to consider factors that are commonly negligible, was the collapse of the cantilever span of the Quebec Bridge. The approximate rules used then to design the ordinary column section were found sadly lacking when applied to the unusually large sections of this span.

We can also include the recent collapse of the Tacoma Narrows Bridge in this category in that the magnitude of the dynamic forces, which are commonly negligible, was not fully realized. What is more we are not too sure what to do when we do fear them. It is probable that exhaustive tests such as have been carried on in connection with airplane design are needed. Such research was being done in connection with this bridge at the time it failed.

Until recently, it has been a habit of engineers to ignore the fact that the materials of which our earth is composed are subject to physical laws. The often quoted slogan, "Solid as the Rock of Gibraltar," has been taken too literally. Ignoring compressibility and plasticity of the foundation materials seldom had serious results so long as fills at the end of bridges were kept low. It may and has had serious results with the present day grading practice of cutting off mountains and piling them up in valleys at the end of a bridge. Fortunately the study of soil mechanics is spreading and previous practice is changing.

The ordinary straight line or parabolic column formulas are good examples of formulas that cannot be used beyond certain definite limits. On the other hand, within the commonly specified limits they may give results that are close to the more accurate theoretical formulas. It will be noted from the chart that results obtained from extending a parabolic curve beyond a maximum value of the slenderness ratio—the L/r—are far from correct.

Safety Factor Had Its Origin in Railroad Practice

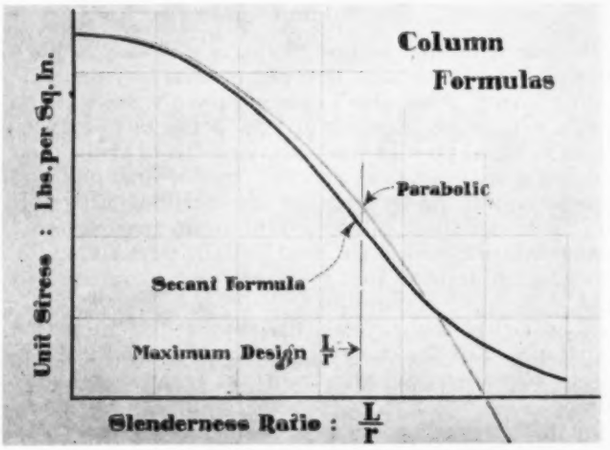
Since allowing for future conditions is more a matter of clairvoyance than engineering judgment, the magnitude of safety factors must be decided rather arbitrarily. Those now used for steel construction had their origin in railroad bridge practice, based on the possible future weight of locomotives. The bridges then were of simple beam or girder design and the allowable working stress seemed to be the natural place to introduce a general safety factor. A value of 16,000 lb. per square inch was adopted and used until a few years back. When a change was being discussed Professor Turneaure made the comment that "The stress of 16,000 lb. has a rather ancient tradition." Starting from this "tradition" some increase was thought proper because of better material and fabrication. Thus, a figure accepted for so long by designers that they had forgotten it was originally a matter of engineering judgment only, and applied only to railroad bridges, is now after minor modification being used for all ordinary structural steel design.

Although it may be necessary to determine the magnitude of the safety factors in a more or less arbitrary manner, it is reasonable to expect that their magnitude should be about the same for all structures devoted to the same use, and also for the individual parts of those structures. Although there are a few cases, such as the pins in steel trusses previously mentioned, where extra large safety factor is not of economic importance, we have considerable evidence to show that the strength of various kinds of structures and structural parts is not as consistent as it ought to be. The situation seems to be getting a bit out of hand.

Perhaps engineers are not altogether to blame for this condition. They are pretty busy grinding out plans and specifications either for the public or for private owners neither of whom can see farther than the cost of the engineering work—and consider it advisable to continually crab about it in order to keep the cost down. Laymen, and some engineering executives too, fail to realize the possibility that a large decrease in cost of the structure may be obtained for a relatively small increase in engineering cost. And the reason they don't realize it is that we engineers can't, or don't make it plain to them. Perhaps it is too easy for us to justify our design practice by stating that it is in accordance with "good engineering practice." It has been said that the greatest inventor the world has ever known, was the man who invented compound interest. Be that as it may, engineers are greatly in debt to the man who thought of the term "good engineering practice." It seems to floor all questioners and cuts out any need for original thinking or the burning of midnight oil in research.

It must be admitted that engineering efficiency requires the adherence to set rules of procedure just as the mass production of automobiles or airplanes can not be carried on economically if changes are constantly being made as the result of new ideas. The man on the assembly line adding a part to a machine has no time to work on improvements if the ultimate in production is to be maintained.

It is also necessary to have common rules to work by it work is to be properly checked. Errors cost money which either the producer or buyer must pay for. If procedure is to be changed to effect economic improvements, it must be done at the right time and applied generally. Changes meet with resistance—there is inertia in human beings that resists a change in procedure just as the inertia of matter resists a change in motion. Concentration on the problem by engineers as a whole is necessary if this inertia is to be overcome and progress made.



Note How Incorrect Results May Be Obtained by Extending a Parabolic Curve Beyond a Maximum Value of the Slenderness Ratio

Text books often define the factor of safety as the ratio of a working stress to the stress at the elastic limit, or at the breaking point. As an arbitrary definition this might do very well, but it is not what we actually think of when the term safety factor is used. We think of it as how heavy a load can a structure hold up as compared to the loads that it actually has to carry. The adoption of a reasonably low working stress is only one place where a factor of safety is applied in design. Other places where they are introduced are in the assumed loading, and in the assumptions as to the distribution of the applied load to each member of the structure. As we have already noted, safety factors also enter through the use of approximate formulas that give results on the safe side.

Law of Probability and Safe Load

The safe load on a bridge or the proper load to use in designing one, is very closely associated with the law of probability. Is it necessary to assume that just the right number of vehicles with the most critical arrangement of axle loads and spacings will be placed in just the right position at one time to cause the greatest possible stress in any part of the bridge? The chance that such a case will occur may be practically nil and the assumption over-cautious in everybody's opinion. A difficulty arises, however, when we introduce a greater element of chance: just where to stop and call it safe enough. Bridge design practice recognizes this factor when it reduces the loading on bridges having more than two traffic lanes. Judgment and actual experience are the only solution to this problem.

We could take a much bigger chance of a failure occurring on a bridge than we do now and still not endanger the travelling public any more than they are endangered in other situations that now give them little concern. However, the public looks on an accident that occurs to them on a bridge as a sort of betrayal of their confidence. The difference between bridge accidents and other accidents is very well brought out in a short editorial handed to me a few days ago and I think it is worth reading:

S.F.Chronicle 11-12-40—"When a bridge collapsed at Tacoma the other day, with the loss of an automobile and a dog, it took columns of news reports, eyewitness accounts, survivors' stories, expert explanations and photographs to tell about it. Now 31 persons are reported drowned in a collision between two Newfoundland ferry boats. A couple of inches of news type tells the story. Odd, isn't it? Suspension bridge collapses are rare but boat accidents are an old story."

The H-Loadings

For the design of highway bridges a set of loadings known as the H-loadings have been universally used for a great many years. That most commonly used in the design of modern highway bridges is the H-15 loading which is based on a 15-ton truck with 0.8 of its load on the rear axle. It assumes that this truck will be followed at a 30 ft. interval by a similar one weighing 12½ tons and for bridge spans of about 60 ft. or longer it is found convenient to approximate these loads by substituting for the trucks a uniform load plus a moveable concentrated load.

How do the actual loads traveling the highways of California or of the other states compare with this loading as to the stresses they cause in highway bridges? Strange as it may appear to some, hardly any two states have the same restrictions as to the maximum legal loads, but California not to be outdone, her custom has probably the greatest load concentrations permitted by any state in the Union.

Using the relative moment in simple spans as a measuring stick, let us compare the factor of safety incorporated in various span lengths when the H-loading is used. The weight on the two rear axles of a 3-axle truck may be about 28,000 lb. or more when overloaded, and these so-called dual axles are commonly spaced about 4 ft. apart. Except in extraordinarily short spans, there is not a material difference between the moment caused by these axles and the 24,000 lb. axle load of the H-15 axle. These axles govern the moment in spans up to about 25 ft. and so it may be said that in these span lengths there is no material amount of safety factor incorporated in the design through the use of the H-15 load.

In the case of longer spans we find that actual loads produce greater moments than the H-15 loading. The dual axles of a tractor unit and a semi-trailer together become the governing loads, and in the case of a 50 ft. span, the moment they produce will exceed that caused by the H-15 load by 50 or 60 per cent under the shorter vehicles permitted by the present California law.

Taking the dead load of the structure *into account* we find that a structure of 50 ft. span length may be stressed some 20 or 30 per cent more than contemplated in its design and this means that some factor of safety, in working stress, distribution formulas or elsewhere, must be introduced to take care of the deficiency. Since these factors are of the same order in all the length of spans mentioned, we see that bridges of shorter span have a greater safety factor under the commonly accepted design loading than those of longer spans. Considering still longer spans the factor of safety is likely quite ample because of the improbability of extreme load conditions. However, it must not be forgotten that long trusses have shorter floor panels which come under the same category as short span bridges.

California and a few other states have recognized this condition for some time and are using a design load in which the H-truck load is followed by a trailing axle simulating the semi-trailer units now in such general use and avoiding this inequality as to safety factors.

How Bridge Structures Behave Under Abnormal Conditions

A few outstanding examples of the way bridge structures behave under abnormal conditions will perhaps bring out the relative importance of some factors affecting structural safety not always realized. Most outstanding in everyone's minds are the *cases* where *complete collapse* occurs under traffic.

There have been three cases of state highway bridges in California where one of the vertical members of a through steel truss of light design was struck by a vehicle which caused the span to collapse at once. In another case a projecting load struck one end post as the vehicle came on the bridge causing the span to collapse in front of it. Another time a light car out of control struck an end post from underneath on the far side of the span and it collapsed. In all these cases the span was of light design but this is of secondary importance compared to the fact that the cross-bracing in all these spans was light and of a design lacking in rigidity.

As against these occurrences we have several outstanding cases where failure of the span did not occur. They include several cases where one vertical of a truss was struck; in another case both end posts at one end of the bridge were badly damaged; in a recent case an overheight load hit the sway bracing at three panels of a truss span pulling the vertical truss members inward from 3 to 12 in. In this last case I happened to be on the span when a load of 12 tons or more in weight crossed it and I could not say there was any definite sign that the strength of the span had been impaired. In these cases the trusses were also of light design but the bracing and its connections were fairly well designed for the period in which the structures were built.

A modern deck steel truss with a concrete floor was struck by a dredger hull during high water and the lower chord completely broken in two in addition to other damage. In that condition the span actually carried heavy loads probably as much as 30 tons.

The lesson to be learned from these events is probably that there was a sufficient safety factor against static loads in all cases but that in the case of dynamic forces the safety factor is greatly increased through the use of proper cross bracing and improved rigidity of the span as a whole. In fact in one case the safety factor is zero and in the other about enough for all practical purposes.

Conclusions

1. There is a certain amount of dry rot in our structural engineering practice due to our not keeping its commonly unseen and easily forgotten derivations exposed to the air and sunlight of common knowledge.

2. Standardization and set procedures are a necessary part of technological progress but we are forgetting that they are not universal in their application and should be modified when the conditions for which they were set up have been changed.

3. There is no substitute for common sense. It will tell you when it is proper to employ convenient methods which are not rigorously accurate, and will also warn you when you are using them wrongly just because of habit or precedent.

The adoption of more rational design practices to obtain greater economies, means more care and judgment in their application and thus will make design work more difficult and probably more costly.

As a final suggestion: Go through your text books on mechanics again. Don't spend time trying to learn the mechanical processes of the algebra or the calculus used to develop the formulas or "laws". Such study may be valuable to you but the resulting brain fag prevents concentration on more important things. Look only at the physical assumptions made to start with and the assumptions made to simplify complex conditions or different mathematical processes. You will find it more interesting than the common habit of learning by heart the formulas and their application. If enough engineers do this often enough the stone walls of precedent and mental inertia will become much less formidable.

PROGRESSIVE PROSPERITY
BASED ON PROFITABLE INVENTIONS

By HALBERT P. GILLETTE
Editor ROADS AND STREETS

AS IS well known, the invention of an economic steam-engine by James Watt ushered in the Age of Power about 1775. But it is not well known that for at least five prior centuries there had been no great economic progress anywhere. The Age of Power therefore was also the Age of Prosperity, partly because mechanical power greatly increased production, and largely because it stimulated the invention of numberless machines for utilizing power.

Hard upon Watt's great invention came Fitch's steamboat, Trevithic's steam-coach and Stevenson's locomotive. Scarcely were these well developed when Faraday invented the embryo dynamo, destined to create an Electrical Age. All these machines were, and still are, mainly dependent upon the steam-engine; but the latter is now being rivaled, and, for many purposes surpassed, by the internal-combustion engine, the type of motor that drives automobiles and air-planes.

The two countries in which this great saga of steam and gasoline has been almost entirely written are Britain and America. Why? Are their people smarter? No, for they are of the same stock as that of Europe. Then why? The answer is that Britain and America have for centuries been, what they are today, free democracies. Let there be emphasis on that word free, and let it also be defined.

A democracy is entirely free only when all its individuals are free to choose their vocations and to develop their abilities, without hindrance by any social powers or governmental authorities. The latter always seek to plan for all the people, rather than let each individual plan for himself. Under such paternalism, numerous great inventors and great business leaders do not develop.

Gray said "Many a mute, inglorious Milton here may lie," for lack of educational opportunity. Likewise many a Faraday may sleep under Russian sod, unsung for any great invention. The Russians "planned it so." They, and all the governmental planners in all climes, from Stalin to Roosevelt, by their mistaken policy of centralized planning, discourage genius. Genius brooks no guiding hand. It leads itself.

In the Encyclopedia Americana, under Invention, there is a chronological "list of important inventions and discoveries" beginning in 1603 and ending in 1918. The total number of inventors and scientific discoverers there listed is 374, whose number and nationality is distributed as follows:

United States	165
England and Scotland	101
France	46
Germany	37
Italy	3
Russia	2
All others	20
Total	374

In those 315 years there were 374 men who, according to the editors of that encyclopedia, contributed most to world progress by invention and discovery. Practically all the discoveries there listed are those that involved the invention of some mechanical device or process of production, so this is essentially a list of inventors.

Let us consider the significance of this list. To the two greatest and freest democracies in the world, Britain and America, belong 266 or 70 per cent of these 374 inventors. To the two least free of the great nations of Europe—Italy and Russia—belong only 5 of these 374 inventions. Yet the present leaders of those two nations that once were kingdoms and now are dictatorships, are two of the greatest advocates of central planning and control of all enterprise. Those two, now joined by a Hitlerized Germany, are preaching the doctrine that free democracies are an economic failure! They have the effrontery to say such a thing when every important invention that they are using to wreak destruction of free democracies was invented either in Britain or America or both. I say both, for I have in mind such inventions as the "tank" which is a combination of an old invention of Sir John Napier (also inventor of logarithms), and D. Roberts, American inventor of the "caterpillar tractor." Germany is assaulting London with bombs released from flying machines invented by the Wright brothers of America, and propelled by gasoline which was originally a product mainly of American inventive genius and business sagacity. All their communication by electrical means they owe to other nationalities, with the exception of Hertz's waves that Marconi developed, but the basic theory of which was that of Clerk Maxwell, the English physicist. Machine guns and breechloaders were invented and first developed in America and Britain, as were iron-clad battleships.

Let us turn for a moment to a bit of statistics that proves beyond question that the Age of Invention is also the Age of Prosperity. In my Handbook of Construction Cost there is a chapter of 100 pages on Prices and Wages in which are given data that go back to the year 1300 A. D. These early data show that for about 500 years daily wages in England did not increase in buying power. Then something very important happened, for in the following 140 years the buying power in the average daily wage increased 350 per cent. In other words in 1915 the average English worker had a real daily wage —that is a wage measured in goods—that was 4.5 times what it had been in 1775. In New England a common laborer averaged 35 cts. a day in 1775 and $1.05 in 1860. By 1915 this had risen to $2.10, so that he was earning 6 fold as much in money as his forebear earned in 1775. In the meantime commodity prices had see-sawed up and down, and in 1915 were, on the average, at the same level as in 1775. Hence his real wage, as well as his money wage, in 1915 was 6 times as great as in 1775. skilled labor, whether it was union-labor that constituted some 10 per cent of the total number of those in

gainful occupation in 1915 or whether it was non-union labor that comprised the 90 per cent. The working hours per week had declined from 66 in 1775 to 48 in 1915. Labor union leaders are fond of ascribing the decrease in working hours and the increase in wages to their efforts; but the bald fact is that this had occurred in countless factories and on farms where no labor-union had ever existed.

The cause of this amazing increase in real wages was an equally amazing increase in production per worker. It could not be otherwise, for a real wage means a wage measured in commodities or goods, and it could not possibly become six-fold without a corresponding increase in productivity per worker. But what had so enormously increased productivity? Not a longer working week, for that had become two-thirds as long. Not harder muscular effort, for that had been reduced by the use of steam, gasoline and electricity. Not greater skill, for that had been built into the machines. Not greater mental ability, for that was as great in the men who wrote the Declaration of Independence as in any statesmen, and as great in the men who fought for its principles as in the men who are now enlisting to fight for the same principles if need be. The cause of this amazing economic progress is to be found only in the application of science by many men seeking fame or fortune—the scientists, the inventors, the engineers and the business leaders of America. They have been relatively few in numbers but mighty in performance. How mighty is brought home strongly to Californians by considering the thousands of workers who owe their jobs primarily to Edison and the Wrights, and secondarily to some scores of other inventors, not to mention the business men who have either brought together the necessary capital or have successfully managed the moving-picture and air-plane industries.

It has become popular to cry down the profit motive, under the delusion that profits are made at the expense of wages. Ford's profits refute that argument, for it is by virtue of them that he has been able to build great plants and employ thousands of men. Yet even in his best year his profit was only 10 per cent of his gross sales. It is seldom that such a percentage is equalled by a manufacturing company. Based on industrial history, American business men increased weekly wage rates in geometrical progression, 10 per cent every 7 years on the average since the year 1775. During depression years few increases of wage rates have occurred, but during years of prosperity such increases have been many and far flung. In his desire to expand a profitable business, the typical business man raises wages in order to attract more workers. So that automatically competition for workers sends wages up, and it sends them up faster the more profitable the times are. Then where do the profits come from? How can they rise when wages are rising? Solely because productivity is rising, and that occurs when scientists, inventors, engineers and business men are enabling workers to increase their output. It is just as simple and as true as that. Yet there is whole raft of would-be reformers who preach an opposite doctrine, and some of them call their doctrine Socialism or Communism. In common all of these have the belief that the worker prospers in proportion as the employer suffers. Hence they decry the profit motive.

If, however, profit is commonly a reward for success-Although the rise in average real daily wages in America had been greater than in England, workers in both countries had experienced an amazing increase in income. What was true of American common labor was true of ful application of inventive and managerial brains plus a rental for the use of capital, it follows that the profit motive is one to be encouraged. By its encouragement American workers have become the real profiteers, the greatest profiteers of all time. In less than one and a half centuries the weekly profit that is called a weekly wage increased 500 per cent. By the side of that gain how insignificant is the 10 per cent that a Ford makes in good times!

Do I hear a "technocrat" arguing that in 1929 all opportunity for further economic progress suddenly ended? Not a decade of the 150 preceding years had lacked its prophet that American economic progress had reached an end. But progress, like Old Man River, kept right on rolling along. Why not? What is there ever to stop its rolling along, save some defect in the economic machine or the fact that every American has all the income that he desires? Defects of the financial system can be remedied; hence long depressions from that cause can be eliminated. It may be less easy to eliminate the false doctrine that a profit is reprehensible.

PORTLAND CEMENT ASSOCIATION FORMS SOIL-CEMENT BUREAU

The Portland Cement Association, Chicago, has organized a soil-cement-bureau. Miles D. Catton, who has been in active charge of soil-cement development since the Association started research in this field seven years ago, has been named manager of the new bureau.

M. D. Catton

The soil-cement-bureau will function in a manner comparable to the other general office bureaus, and will be responsible for direction of promotion, testing and supervision of construction of soil-cement mixtures in their various field uses.

Since the first project was started in South Carolina in 1935, soil-cement construction has found its way into all sections of this country and to many foreign countries. As of January 1, 1941, 242 projects in 35 states were either built or under construction. The yardage involved in these projects is the equivalent of 700 miles of road 20 ft. wide.

MONTGOMERY GOING AGAIN

Julian Montgomery, who resigned as state highway commissioner of Texas because of ill health, is back in circulation. After a prolonged rest he is again physically fit and has opened a consulting office at 606 Littlefield Building, Austin, Texas.

Conference on Roadside Development—The first annual conference on roadside development will be held Feb. 28 and March 1 under the auspices of and at Ohio State University, Columbus, O. State and federal engineers and landscape architects are to be on the program. It is expected this conference will be repeated yearly.

North Atlantic States Highway Officials to Meet at Boston—The 17th annual convention of the Association of Highway Officials of North Atlantic States will be held at Hotel Statler, Boston, Mass., on Feb. 19, 20 and 21. A. Lee Grover, Secretary, State Highway Department, Trenton, N. J., is Secretary-Treasurer of the Association.

NATIONAL DEFENSE HIGHWAY FUND REQUIREMENTS

A Survey by ROADS AND STREETS *Indicates Special Federal Authorization Will Be Needed*

CONTINUED FROM THE JANUARY ISSUE

UNAVOIDABLE conditions in "making up" the January issue required us to omit part of the national defense highway funds requirements survey data. That which was omitted then is included in the following and should be considered together with the data published in January. Now, as then, we wish to make clear that this information does not represent the views of either the War Department or the Public Roads Administration. It does, however, represent the views of the states surveyed. A summary of the data indicated that funds in excess of one and one-half billion dollars would be required to satisfy the needs of the roads on the strategic network to bring them up to the minimum standards.

The balance of the state reports follows:

Tennessee

The strategic highway mileage in Tennessee consists of 982 miles of first priority, 47.7 miles of second priority, and 60.5 miles of alternate mileage. To bring this mileage to a standard considered adequate for the safe and speedy movement of war equipment, the following estimated improvements would of necessity be required.

688 miles of roadway widened by grading and drainage at an estimated cost of $10,803,900. 278 miles would have to be reconstructed, requiring grading and drainage at an estimated cost of $7,951,400; 12 miles of surface widened at an estimated cost of $123,500; and 289.6 miles of surface reconstructed at an estimated cost of $8,445,700. 26 bridges with span length less than 85 feet would have to be replaced at an estimated cost of $1,203,700, and 10 over 85 feet span length, at an approximate cost of $9,125,000. 3 underpasses reconstructed at a cost of $180,000, and 7 overheads at an estimated cost of $414,200.

The total estimated expenditure would be $38,108,900.

No provisions have been made for financing the above construction and/or reconstruction, and if all the available construction funds, both federal and state, were applied to these improvements, only a small part of this mileage could be rebuilt each year.

Texas

From the 23,500 miles Texas highway system, approximately 6,300 miles of these designated highways have been designated as being of strategic military importance by the proper defense agency. Texas occupies a very important position as related to the national defense, due to the fact that its southeastern boundary borders the Gulf of Mexico and its southwestern boundary borders the Republic of Mexico. These two vulnerable borders make Texas extremely conscious of the importance of prompt and adequate preparations for the national defense.

A careful estimate has been prepared of the funds that would be necesary to bring the 6,300 mile strategic military network system up to the minimum requirements of the War Department. This estimate indicates that an expenditure of approximately $80,000,000 would be necessary to accomplish this purpose and there is little doubt but that such expenditure is most important to the national defense and should be made as rapdily as funds may become available for such purpose. The Texas Highway Department receives its normal allocation of regular federal aid funds, railroad grade separation funds, and secondary highway funds from the Public Roads Administration. These funds, after having been matched with the necessary state funds, comprise an anual program of approximately $15,000,000. It will be readily seen that if all of these federal funds, after having been matched by state funds, should be applied to this strategic military network, it would take approximately six years to bring this network up to the minimum standards required by the War Department. In the meantime, under such a possibility, the remaining portions of Texas not involved with the strategic military network would be required to take a six year holiday in highway construction. Since it is considered of equal importance that foods, supplies, industrial developments be utilized to the fullest advantage in the national defense, it is readily apparent that such a road building holiday in the remaining portions of Texas would not be conducive to proper coordination of all of our resources at these crucial times.

In an endeavor to be of every assistance possible in the preparations for the national defense, the Texas Highway Commission has declared its intention to cooperate with the federal government in the construction and maintenance of highways on the Texas highway system that are considered of strategic military importance by the proper defense agencies. It has expressed its willingness to match federal funds as required to facilitate the construction of these highways and has agreed to give priority preference to such highways in the formulation of its next federal programs of work. In taking this action the highway commission further directed the attention of the national Congress to the needs for additional appropriations for the construction and maintenance of roads the primary purpose of which is to provide access to military training areas, as well as Texas highways which are considered of strategic military importance by the proper defense agencies. In calling this matter to the attention of the Congress, the Texas Highway Department has tendered all of its engineer-

ing facilities to the federal government in the construction of military access roads at such time as funds may have been made available by the Congress for the construction of such roads.

Utah

The highways of Utah forming the strategic military network comprise 1,300 miles, of which all but some 200 miles are included in the principal U. S. numbered system. In general there are two routes crossing the state from east to west, one from north to south, and one from the east to the northwest. A glance at any highway, railroad, or airline map will show the significance of these highways and the radial importance of the Salt Lake Valley, which includes the populous part of the state, to all points on the Pacific Coast.

Included in this 1,300-mile network are nearly all of Utah's most important highways from a standpoint of normal peacetime traffic, roads which were improved to all-weather standard relatively early. In more recent years emphasis has been placed upon the development of roads in the outlying parts of the state, and only a start has now been made in the return of a concentration of construction upon these highways in the center of the state.

Utah in common with most of the states has thus just fairly begun the great highway modernization program which recent increases in the size, weight, and speed of vehicles is absolutely demanding. This modernization includes the straightening of sections of unsatisfactory alignment, and by widening highway surfaces provides for increased traffic capacity. There is urgent need in Utah for a multi-lane highway approximately 125 miles long, this forming the backbone of Utah's highway system as well as the most important link of its strategic military network. Only a few miles of this section have been adequately rebuilt to the desired standards.

A cost summary, tentative only, of the cost of improving strategic highways, and not including rights-of-way, special development in industrial areas, camp areas, etc., follows:

	Mileage	Cost
First priority	825.5	$10 280,000
Second priority	322.9	6,504,500
Third priority	163.0	4,041,900
Total	1311.4	$20,826,400

As in the other arid states of the West, the construction program in Utah is measured almost directly by the amount of federal aid available to the state; and based on present federal apportionments and including state funds for matching, there is available to Utah approximately $2,000,000 annually which might be applied on the strategic military network. It is plainly seen that without increased funds for highway construction, the improvement of these important highways to meet peacetime needs will be very difficult of accomplishment, without giving consideration to the increased tempo of construction made desirable by military needs.

A substantial mileage of the strategic network is located through mountainous areas, and the requirement even to supply the intermittent extra width grade necessary for military needs is going to affect seriously the progress of normal highway development unless augmented funds for this purpose are made available.

There is being developed in the Salt Lake Valley a number of important national defense projects including a major airfield, an army supply depot, and adequate facilities for the training of an army air unit. To serve these areas additional access road construction is urgently needed which, though not large in mileage, will represent perhaps 10 per cent of the cost of all needed work on the military network. If special defense funds are not made available to meet the construction needs of these access highways, and as a result only the present appropriations are used for these purposes, the normal construction program on the network itself will be seriously hampered.

These facts plainly indicate that in order for Utah to make a substantial showing of highway construction in the interest of national defense, additional funds must be made available.

Vermont

The initial military highway program for Vermont contemplates the inclusion of 845.2 miles of highways of which 834.7 miles are on the state highway system. 799.8 miles of the national defense system as well as 21 bridges should be considered as of immediate concern for improvement to conform to national defense standards. The estimated cost of the highway construction is $19,679,170 and of the twenty-one bridges is $2,046,000.

We feel that special defense work for roads should be covered by special appropriation from the federal government; and we further feel that it is up to the national defense authorities to determine what roads are needed for defense purposes.

West Virginia

Today, the relationship of highways to the national defense is a problem of compelling importance. Fortunately the roads designated by the War Department as strategic or defense highways are at the same time most important for normal civil use, and to a large extent now constitute a part of the federal-aid system, hence these defense highways present no conflict with local interests.

There are many sections of road on the strategic system in West Virginia which do not now meet the required minimum standards specified by the War Department. Sharp curves, steep grades, narrow and inadequate bridges must be eliminated while at other points the road surfacing and road shoulders must be widened.

The highway defense program presents no very serious problem insofar as drastic changes in location of highways is concerned. However, many miles of these roads including bridges must be improved in various ways—by-passes may be needed to avoid narrow, congested city streets. Many states, including West Virginia, will find a serious problem here in that they cannot, through their regular federal-aid alone, do this work without seriously impeding development of other important highways in other sections of the state.

West Virginia needs $19,000,000 to bring its strategic highways up to defense standards.

Estimated cost of necessary work is as follows:

	Miles	Cost
Right-of-way	169	$ 4,583,300
Relocations	337	5,998,300
Roadbed widening	41	165,700
Sight distance improvement	44	92,000
Shoulder improvement	34	138,000
Drainage	20	98,600
Surface widening	162	2,270,100
Surface reconstruction	233	5 326,300
Bridges	Number	
Strengthening and widening	3	80,000
New structures	10	428,000
Grand total cost		$19,180,300

Experience in West Virginia has shown that rights-of-

way costs are an important item in the relocation and widening of existing main highways. Infrequently the cost of necessary right-of-way exceeds the reconstruction cost, but it consistently represents a principal item in the cost of reconstruction.

The improvement of defense highways, if the job is to be done promptly and efficiently, requires the sympathetic cooperation of the federal and state governments. Since the states will derive the full benefit of these strategic highways for general road purposes they should bear a part of the total cost of the highways, perhaps twenty-five to thirty-five per cent. However, it should be borne in mind that total cost includes rights-of-ways, damage to abutting property, engineering and inspection.

When it is recognized by both the state and federal governments that our highway systems, as they now exist, are not adequate, in the judgment of those who should know, to properly protect us in a national emergency such as now threatens, and when it is fully realized that a strategic network of adequate highways is as much a part of the national defense program as the production of guns, airplanes, tanks and shells, I have no doubt but that the necessary funds will be forthcoming to do the job, just as billions of dollars have recently been authorized to carry out other phases of our national defense program.

Wisconsin

From our understanding of the defense highway needs we find it difficult to hazard even a guess as to the special appropriations needed for such purpose, for reasons we will attempt to set out.

Starting with the estimates recently prepared for improvement of the "strategic network" in this state on the basis of prescribed minimum standards, we find that such standards deal primarily with the structural strength of existing pavements to carry the loads imposed and to provide roadbed width and stabilized shoulders. No consideration was given to restrictions existing as imposed by steep grades, sharp curves and restricted sight distances as they might affect the capacity or safety of such routes to carry existing traffic. For this state our estimate of rebuilding approximately 1,400 miles of the "strategic network" to the minimum standards prescribed was approximately $17,500,000. No less than 50 per cent of the work so estimated, while proposing desirable improvement such as widened roadbeds and stabilized shoulders, would not be initiated and undertaken by the state at this time. If funds for highway improvements in an amount necessary for such rehabilitation work were available, this state would feel that its primary obligation was to complete unimproved gaps in other existing primary routes and that rather than shoulder widening on obsolete sections of routes carrying heavy traffic basic and complete reconstruction of such routes to accepted present-day standards should be undertaken with such funds. In this we do not mean to criticize objectives or minimum standards used as a basis of estimating improvement of the "strategic network" but rather to point out that such palliative improvements might defer needed construction or reconstruction both on the "strategic network" and on other primary routes in which the state is vitally interested.

As to roads for camp areas, we have possibly one military reservation in this state. We understand federal agencies have made surveys and estimates of highway improvements considered necessary and desirable based on the intended purpose or usage of such military area. The highway commission does not have information as to the possible plans for utilization of such military areas, and hence is in a poor position to estimate highway improvements needed for such utilization. Deficiencies no doubt exist in certain of the access and reservation roads which are outside this commission's jurisdiction. Some improvement in the access roads is justifiable for the service to be rendered for normal highway traffic. Improvement beyond such minimum as may be necessary for effectively rendering service to the area as a military training center or the like should unquestionably be a charge against the maintenance and operation of such military reservation or area. Under the conditions and considering our lack of information, we would not presume to estimate the funds needed for such purpose.

Similarly we lack tangible information on street improvements needed because of expansion in serving defense needs. We appreciate that in many cities large expansion of industrial plants and personnel for defense work will create special problems in interplant transportation and the transportation and parking of vehicles of increased personnel employed at such plants. We do not have tangible information to indicate that such situations are critical or are becoming critical in cities in this state, and hence are unable to estimate such needs.

No doubt the authorities in charge of coordinating the nation's defense program will find that defense needs will require immediate improvement of certain streets or highways. The extent to which such improvements must be accelerated beyond that which would exist under a normal program would necessarily be a problem for special federal financing. Our department is cognizant of many improvements that are needed and should be made in our highway system, including the "strategic network"; however, in the light of information available we are reluctant to estimate in dollars and cents the extent or amount of federal funds that should be made available to this state for highway improvement because of defense needs.

Wyoming

Many of the highways in Wyoming are still inadequate, both from a geometric and structural design standpoint, for present or immediate anticipated peace-time traffic. Fortunately, the reconstruction work which has been done by the Wyoming Highway Department for the past several years has been on the tentative inter-regional highway system and on first priority defense highways. These newly constructed sections have been of a type and priority which were governed by normal traffic considerations. Current programs have been governed by similar criteria. The standards used provide for two 12-foot lanes. The present registration and gasoline taxes have been and are adequate to continue this program when supplemented by regular federal aid funds.

After allowing for administration, maintenance and other necessary activities of the highway department, and the matching of federal funds, only enough funds are left to take care of a small part of the secondary roads which are needed. The standards of construction set up by the defense authorities call for additional shoulders which would greatly increase the cost per mile of those now being incurred, so the state is faced with the problem of building less miles of greater width, or continuing to build miles of less width. There is only one answer to this dilemma, i.e., increased federal appropriations for widening of roadways and strengthening of bridges. It is fundamental that the highway user tolls referred to above can in justice to the highway users themselves be used only for construction to design standards adequate for the traffic.

OBSERVATIONS BY THE WAY

By
A. PUDDLE JUMPER

¶ New style low bridge handrail, in Texas, shown here with flaring curbs at bridge ends on new structure over the San Bernard River in Fort Bend County, Texas, on U. S. 96. Note the

reflectorized curb construction. Texas is studying bridge design with a new point of view.

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¶ Another type of handrail and flaring approach curbs on 524 ft. widened trestle span between Houston and Beaumont, Texas, on U. S. 90.

Bridge Engineer Wickline says that no extra piling was used to widen this structure from 20 to 24 ft.; brackets were built out.

• •

¶ Some time ago a local department store ran the following ad: "WANTED: Young man to work after school and Saturdays, with knowledge of ladies underwear." Two hundred and fifty young men answered the ad, only four of whom had had any sales experience.—*Lifted from the Wyoming A.G.C. bulletin.*

¶ Here is a prize winning photograph. A young lady took a picture of her pet. It is a closeup picture and a good one. What is the pet? Most

people cannot see this picture. Yes, it's right side up. See the note in the lower right corner of the right hand page.

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¶ Governor O'Connor of Maryland recommended a five-year road construction program costing $55,000,000 to be financed in large part by an increase in commercial vehicle registration fees. A twenty-year road program costing $216,000,000 also is recommended.

¶ Michigan has just published a new highway map. State game areas, state and national forests, airports, fire tower, etc., are shown along with the surface types of the various roads. The reverse side shows touring and recreational scenes in Michigan.

• •

¶ Mom: "Where is Jimmy this afternoon?"

Pop: "If he knows as much about canoes as he thinks he does, he is out canoeing. But if he doesn't know any more about it than I think he does, he's swimming."

• •

¶ Contractor: "Does the foreman know the trench has caved in?"

Laborer: "If he doesn't we'll tell him as soon as we dig him out."

• •

¶ Here's a typical view on the Pennsylvania Turnpike at night. It shows only one direction, the traffic from the other direction, on the other side of the median strip, travels to the left of that left hand line of reflectorized, postmounted buttons. These reflectors are about 100 ft. apart the full length of the turnpike, except of course, in the tunnels. They are an excellent driving aid for me because I travel fast and need a long sight distance ahead.

¶ Remark that will some day be rated as a "Famous Saying" is the following by Mr. E. W. Wendell, Assistant Chief Engineer, New York State Department of Public Works, in discussing the use of standards in the design of bridge substructures: "An artisan dexterity covering the manipulation of standards can never be substituted for the understanding analysis of variability, with the application of creative reasoning."

• •

¶ Mr. A. E. Russell of the North Dakota State Highway Department is holding his traffic counting invention and pointing at the diaphragm actuator. He patterned it after the idea developed by Mr. Norman, namely, the works of a clock. (Norman used a watch). The diaphragm of dentists' rubber is open on one side through an inner tube valve to a long rubber tube, sealed at the end, that stretches across the road. On the other side of the diaphragm a plunger which just touches it in the normal position, actuates the balance wheel stops of the clock works when the plunger is pushed. The hairspring is removed and replaced in such a way that its tension on the diaphragm can be adjusted. The clock arrangement requires two axles to cross the rubber tube to record one vehicle. This also records one second. Hence, a second is equal to one vehicle. Sixty seconds represents 60 vehicles, so the clock face is calibrated in vehicles instead

of seconds, minutes, and hours. A vehicle axle crossing the rubber tube, compresses the air and bulges the dentist's rubber diaphragm. The diaphragm bulge actuates the balance wheel stop. Two motions of the balance wheel stop records one second, thus one vehicle. Simple, eh?

¶ One of Fred Panhorst's boys in the bridge department of the California Division of Highways drew up this cartoon to stir up a little action on the design of access road bridges. The original, in color, hangs on the wall of the bridge department designing room as an incentive for the designers. I think Morey "missed" the boat." The cartoon, I believe, was drawn to scare little children. Kidding aside though, notice how typically the poor guy got his necktie caught under the T-square?

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¶ On a three-lane highway leading up a hill outside Nashville, Tennessee, the inside third lane has been colored red to mark a route for slow traffic. Vehicles may take their time climbing the hill in this lane while other cars use the clear two-lane road.

¶ Note: Put this outline on the picture of the girl's pet and you'll soon see what you failed to see at first. Let this be a lesson in tolerance.

Maybe there is something to the other fellow's story. Give him a chance to show it to you. Maybe you didn't see the whole picture at first.

ABSTRACTS FROM TALKS, REPORTS, AND ADDRESSES BEFORE RECENT CONVENTION OF AMERICAN ROAD BUILDER'S ASSOCIATION

Active Energetic Conventioneers Crowded all Sessions and Clinics. Large Array of Prominent Speakers On Pertinent Subjects

CONCLUDING a most successful annual meeting, conventionites of the American Road Builders' Association left New York after inspecting parkway construction in the city, in New Jersey, and out on Long Island. All meetings were attended to the capacities of the various meeting rooms, and the convention as a whole, as one engineer expressed it, was "the best convention the American Road Builders' Association has held in 10 years."

Mr. V. J. Brown, Publishing Director of ROADS AND STREETS, who was Chairman of the 1941 A.R.B.A. Convention Program, received the following from an eminent engineer by letter: "I wish to take this opportunity of congratulating you on the splendid convention program and very large array of prominent speakers addressing it on very pertinent subjects. It is my opinion that this convention will go down in history as being one of the most productive in the existence of the association." This clearly expresses the character of the program.

The meeting was called to order by Mr. C. M. Upham, Engineer-Director, American Road Builders' Association, and conventionites were welcomed to New York City by Mayor F. H. LaGuardia. Among the points stressed in his welcoming address, the mayor stated that New York and other cities do not receive their proper share of gasoline tax collections. He said that protection for the cities must be provided in federal laws. He also told about the effort and expenditures that have gone into the production, over the past seven years, of the large mileage of parkways in and around the city. One particularly experienced remark was to the effect that a single snow storm in the city can wreck the budget. Only too well did many of his listeners experience that same difficulty.

The convention sessions were broken up into:

a. General sessions
b. Technical clinics
c. Educational clinics
d. Technical Airport clinics
e. Planning clinics
f. Contractors' clinics
g. County officials' clinics
h. Economics forum
i. Pan-American session
j. Inspection tours

Several meetings were in progress at one time except for the two general sessions.

Following are abstracts from some of the talks, reports, or addresses delivered.

GENERAL

Our Job

By H. G. SOURS
President
American Road Builders' Association
Director, Ohio Department of Highways
Columbus, O.

PREPAREDNESS was the keynote of the annual address of Hal G. Sours, director of the Ohio Department of Highways, before the recent American Road Builders Association convention in New York — preparedness by bringing into existence the greatest system of commercial and military roads to be found anywhere.

An appraisal of America's defense highways might be grouped into three classifications, Director Sours said—those leading into military camps and bases, those located in the areas occupied by industrial plants engaged in production of defense materials and equipment, and the strategic network made up of principally inter-regional roads.

"It can be proven readily that highways which serve essential military purposes, also serve important commercial purposes," Director Sours asserted. "A war of invasion always strives at the important industrial and shipping centers, as well as the nation's sources of materials and supplies.

"Even if such points are not immediately accessible they are always the ultimate military objectives.

"This means that the areas where the population is the greatest will usually be the most seriously affected. Such areas have the greatest need for commercial highways, and certainly, moreover, are the greatest in need for military purposes.

"No one can justly criticize a nation for spending adequately for defense purposes.

"In the case of highways we build facilities which serve military and commercial purposes alike. There are definite and tangible benefits derived, every day, whether we are at peace or war.

"It is difficult for our people to conceive that there is anything which serves us equally well under both conditions, and I seriously doubt if we in the United States think of highways in this light.

"I am of the considered opinion that we should not talk about the building of highways as an expenditure, but that we should, on the other hand, consider them as an investment—and that we should attempt to show the benefits received from such investments from a commercial point of view, and along with this, the vital importance of our highways as an element of a military machine."

Director Sours went on to say:

"We have, over a period of time, gradually expanded our system of improved roads by developing inter-city connections, and in addition have reached into the rural sections with a network of secondary highways and farm-to-market roads.

"The result of this expansion has been a serious overloading of arterial routes into our centers of population.

"As a result of all this, the states and the federal government should seriously consider the appropriation of earmarked funds for the purpose of improving and assisting in the improvement of the extension of state and federal routes into and through the cities.

Access Roads and Strategic Highway System

By W. CARTWRIGHT
Chairman Roads Committee
U. S. House of Representatives

A FEW months ago it was generally thought that the improvement of interregional highways, the most important long-distance traffic routes of the nation, would be a matter of first concern to national defense officials and to the members of the new congress in this important new year.

But now it is apparent that access roads to military and naval reservations and defense industrial plants are of more immediate urgency and must be given first consideration.

The national defense program has created a job of immediate urgency—that of building about 4,000 miles of roads and streets within, and in the vicinity of, military and naval reservations and defense-industry sites, and of correcting the worst conditions on the strategic highway system. Since the interregional system forms the most important part of the strategic system, critical weaknesses will be strengthened. But the immediate and urgent defense needs will occupy our whole attention, and a large undertaking requiring a period of years for its accomplishment must necessarily be deferred.

We should all keep in mind that there are three principal defense agencies: The War Department, the Navy Department, and the Advisory Commission to the Council of National Defense. The defense program in all of its wide ramifications is generated by or flows through these agencies, so when we speak of the highway program for the national defense we must think in terms of the findings which have been made by one of these agencies, in which are lodged authority to determine the validity of the defense character of a project.

A short time ago I was informed that approximately 175 military and naval reservations and industrial plants had been certified to the Public Roads Administration as areas in which the roads serving them are of defense importance. This list is constantly growing. These roads in general are the connections between the roads and streets within the reservations or plant areas, and the arterial roads in the vicinity and nearby communities. Within this category are numerous roads, most of them of relatively short mileage, but very important and necessary for the efficient functioning of the particular facility which they serve. These vital centers of defense which have been designated are scattered widely from coast to coast but the concentration is more marked along the Atlantic Seaboard.

It has become apparent that these access roads are of immediate urgency and must be given first consideration. The partial estimates now available indicate that the Army and Navy alone have need for about 3,000 miles of access and reservation roads which if adequately improved will cost around $200,000,000. The job of planning these access roads is under way, and in many cases the actual construction with the regularly available federal and state funds is going forward. The state highway departments are cooperating in making plans and surveys and supervising construction work.

The Roads Committee of the Congress are ready to give prompt consideration to any recommendations for additional legislation which may be necessary to properly deal with this problem.

Strategic Highway Network. — A critical review extending over the past two years resulted in the approval by the War Department of a system of major routes which we call the strategic network. It is thus apparent that the cooperative road progress of the States and Federal Government has since passage of the Federal Highway Act of 1921 been very largely concerned with the improvement of those roads now incorporated in the strategic network.

In addition to the estimated 30,000 miles in the proposed interregional highway system, there are about 45,000 miles on routes in the next order of military importance. Thus the strategic network as designed comprises substantially the 75,000 miles of most heavily traveled highways of the nation.

The program of eliminating the most pressing weaknesses in the strategic network will include shoulder widening, new surfaces, and in particular the replacement of sub-standard bridges. Some work of this nature, of course, is being done steadily in practically all of the states financed with regular Federal and State highway funds, and with the cooperation of the Works Projects Administration in some cases.

We Learned a Lesson

By GEN. ROBERT LEE BOBBITT
Texas Highway Commissioner
Austin, Tex.
Chairman
Defense Roads Committee
Western Association of State Highway Officials

AN URGENT need of the national defense program is to speed up improvement and construction on the 75,000 miles of state highways making up the strategic military highway network of the United States. This was the declaration of General Robert Lee Bobbitt of San Antonio.

Larger allotments to the states of federal highway user taxes and special appropriations from national defense funds will be necessary to bring this about, he said. General Bobbitt pointed out that highways are a major part of the national defense program, and warned:

"National defense highways should not be delayed or detoured. They should get the green light just as much

as the rest of the defense program for they are indeed the roads over which national defense is to be speeded and carried on."

The Texas highway commissioner told how the Army maneuvers in East Texas last spring and the recent movement of troops into the many training camps and areas in Texas "definitely show the great need for better roads and highways throughout the nation for adequate defense purposes in this era of highly mechanized military forces." He described how the relatively small number of troops and comparatively light guns, tanks, trucks and other mechanized equipment engaged in the maneuvers were dangerously handicapped and delayed by the inadequate highways and also how the roads were damaged as a result of the maneuvers.

"Military experts and high Army officers saw conclusively there that one of the greatest needs and one of the biggest potential bottlenecks in our national defense program is our nation's highways," General Bobbitt said. "From the experience there it was definitely realized what a mechanized, modern, military blitzkrieg meant to an unprepared France. Modern armies must have modern highways."

General Bobbitt emphasized that the 75,000 miles of strategic military highways designated by proper national defense agencies include some 14,000 miles that must be improved and strengthened to the necessary bearing strength for heavy military equipment; that there are 1,800 bridges incapable of supporting loads exceeding 30,000 pounds; 1,700 bridges with a horizontal clearance of less than 18 feet; and 150 bridges with a vertical clearance of less than 12½ feet.

The total of direct highway user taxes collected annually by the federal government is estimated at approximately $450,000,000, General Bobbitt explained. He added that the authorization for roads for the federal fiscal years of 1941-42 was reduced from $230,000,000, as recommended by the House and Senate Roads Committee, to $178,500,000 during the 1940 session of Congress. This should be increased now because of national defense needs, he said.

General Bobbitt, as chairman of the Defense Roads Committee of the Western Association of State Highway Officials, outlined the action of this group at its recent meeting in Denver in unanimously adopting an agreement pledging full cooperation with the national defense agencies in a solution of the problems of improving and constructing highways for national defense. The group, including 12 western and southwestern states, urged that additional federal appropriations from road user taxes and national defense funds be immediately allocated to the various states in order to speed up work on the military network highways.

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Highway Transportation in the Defense Effort

By PYKE JOHNSON
Executive Vice-President
Automobile Manufacturers Association

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FOR ROAD BUILDERS, just as for the men who make the motor vehicles, national defense has become today's paramount job, and highway development to meet the constantly growing needs of civilian traffic must be subordinated temporarily to the requirements of military mobility.

When the emergency ends, however, the nation will confront an acute shortage of facilities adequate to provide for the safe and efficient movement of highway traffic.

At the same time highway transportation, as an industry, will share in the responsibility for absorbing into useful, peace-time pursuits the hundreds of thousands of workers who will be released from defense jobs.

The outlook calls for immediate and far-reaching planning. It is somewhat analagous to the situation which faces a motor vehicle manufacturer when he undertakes to duplicate in large quantities a new automobile, or a tank, machine gun or airplane engine. .

The manufacturer's "make-ready" work includes the design and construction of tools and machines, the training of personnel, the layout of plant, the making of laboratory tests, the scheduling of materials and many other painstakingly detailed preparatory tasks.

In the field of highway transportation generally, the "make-ready" planning must deal with such questions as right-of-way acquisition, allocation of revenues in accordance with traffic needs, off-street parking facilities in urban areas, and, underlying progress in all directions, a thorough public understanding of the highway system in terms of its modern economic significance.

Motor transport's continuing contribution to a better America will be measured to a considerable degree by the scope and vigor of the planning which lies immediately ahead.

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Canada's Queen Elizabeth Highway

By R. M. SMITH
Deputy Minister
Ontario Highway Department

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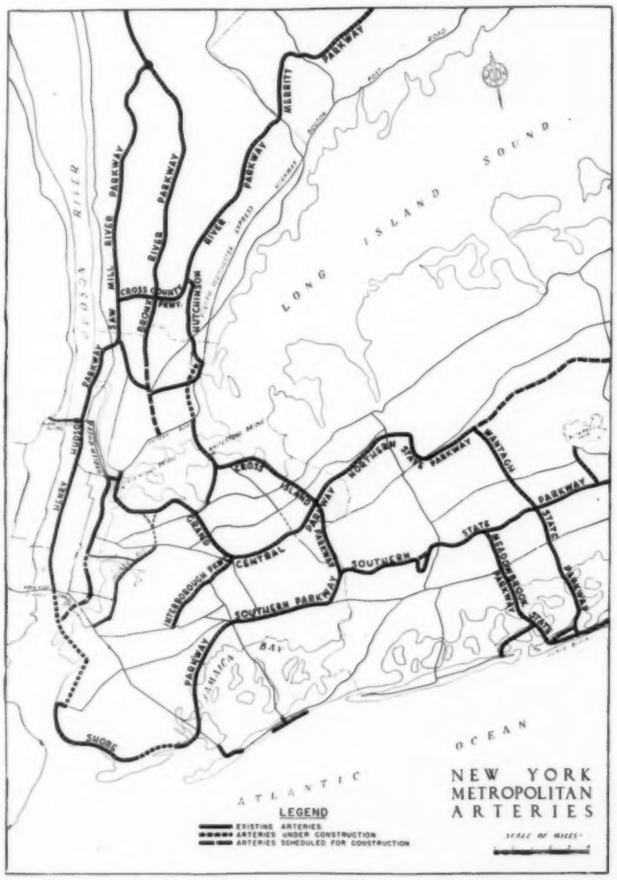
WITH the completion of the construction of the dual highway from Toronto to the Peace Bridge at Buffalo, N. Y., a distance of approximately 100 miles, Canada will have possibly the longest continuous toll free stretch of divided 4-lane highway in America. The road, popularly known as the Queen Elizabeth Way, passes through one of the garden spots of the Province of Ontario and serves as well many industrial cities encountered en route. While the location of the road provided for the by-passing of congested municipalities, ample provision is made for suitable entry and egress. The road is an example of the last word in highway safety engineering. It is lighted from Toronto to Niagara Falls and will be lighted to Buffalo when the last section of the road is completed this year. Directional lanes on this new highway are separated by 30 ft. grass boulevards; the outside or driving lane is 11 ft., with passing lane 12 ft. in width. Water may be drained to sides or to the center. The work will cost in the neighborhood of $20,000,000. The Province of Ontario has projected approximately 1000 miles of this type of development.

Canada believes that first class highways are a war time necessity and certainly a peace time need. The Province of Ontario is expanding its road system to the limits of its ability, having, of course, its war time responsibilities in mind. We are quite conscious that money expended in the developing of our province will result to our advantage when this trial through which we are passing clears away. We earnestly believe in our future and unhesitatingly go forward to meet it. Canada is a land of great distances—a far flung empire of farm lands, timber limits and mining centers, thriving municipalities, healthful and restful countryside, unlimited tourist attractions and a homely, kindly people. Many miles of express highways, modern in every sense, are being laid to outlying centers, not always to the standard of the Queen Elizabeth Way, but safe for rapid movement, comfortable and easy to drive.

Parkways and the Public

By S. M. SHAPIRO
Assistant Chief Engineer
Long Island State
Park Commission

THE arterial parkway system in New York City and Long Island, under the administration of Commissioner Robert Moses since the inception of the program in 1926, consists of 153 miles of completed 4-lane and 6-lane concrete roadways with all crossings at grade eliminated. A total of 252 grade-separation structures have been erected. The system provides for rapid traffic move-



ment along the entire circumference of New York City and through the interior of the city, connects with all of the major thoroughfares leading from the bordering communities of New Jersey and Westchester County, and extends out into Nassau and Suffolk counties on Long Island.

Three-Level Bridge Along Approach to Bronx-Whitestone Bridge on the Queens End, New York City

Henry Hudson Parkway at 79th Street Along the Hudson River, New York City

Construction consists primarily of 8-inch-thick reinforced concrete pavement, with no exits or entrances except at specific and regulated intervals, with a landscaped roadside, with billboards prohibited, and with the latest features of traffic comfort and safety incorporated in the design. The bridges for the most part are reinforced concrete structures faced with stone. Included in the system are the five large bridges under the jurisdiction of the Triborough Bridge Authority, namely, the Triborough Bridge, the Bronx-Whitestone Bridge, the Henry Hudson Bridge, the Marine Parkway Bridge and the Cross Bay Boulevard Bridge. With the exception of these bridges and their approaches, the entire system is under the jurisdiction of the New York City Department of Parks. The parkways on Long Island, outside of the city limits, are under the jurisdiction of the Long Island State Park Commission and were constructed in cooperation with the New York State Department of Public Works.

New Northern-Wautagh State Parkway, Nassau County, Long Island, New York

In connection with this program, the following statement by Commissioner Moses is of interest:

"Today we are well on our way toward a sensible solution of this problem in the metropolitan area. The 153 miles of completed parkways, the Triborough Bridge, Whitestone, Henry Hudson, and other bridge projects, the new 35-mile Belt Parkway project in Brooklyn and Queens, and the many other improvements completed, under way or planned, have established a pattern for an unparalleled arterial system made possible by the cooperation of the federal, state, city, county and other au-

thorities who have provided the necessary lands and funds to carry these projects forward."

[Inspection tours were arranged in New York and New Jersey to see these developments.—ED.]

PUBLIC RELATIONS

Plan To Strengthen U. S. Morale

By ED. L. BERNAYS
Public Relations Counsel
New York City

A THREE-POINT program to revitalize American democracy and strengthen our psychological ramparts was outlined before the Public Relations Forum of the American Road Builders Association by Edward L. Bernays, author of "Speak Up for Democracy" and public relations counsel.

He called for a strengthened democracy through the realization of the ideals of equality, equal opportunity and orderly justice; mastery of the strategies and techniques of persuasion to induce Americans to "speak up for democracy," and the establishment of an Advisory Morale Commission composed of sociologists, psychologists, neurologists, educators, military specialists and experts in communications and public opinion, whose findings would be available to government and private agencies.

"America's first line of defense," he said, "is in the minds of her people. The physical defenses we are now building will be completely effective only if our psychological defenses are equally strong, if our people have an abiding faith in the future of democracy, in its institutions, in everything for which it stands.

"Morale is behavior which advances our national interest. Individual morale is dependent upon our physical and emotional well-being, upon a common goal, a belief in our leaders, a trust in one another despite obstacles and conflict. Group morale follows the same broad principles. Under strong morale we have eager, energetic team work; under low morale, apathy, frustration, confusion.

"The state of morale in the United States has suffered in the last 10 years from depression and ensuing psychological and economic insecurity, from military successes of the Axis powers, and from anti-democratic propaganda from within and without our borders. The results are that our morale is not good and that we need to strengthen it."

The three recommendations made will, according to Mr. Bernays, who served on the U. S. Committee for Public Information here and in Paris during the last war, definitely meet the situation.

Roads and the Rural Press

By W. S. GORDON
Western Newspaper Union
Baltimore, Maryland

AMERICA today is definitely not a country wherein the majority of its people are centered in cities. On the contrary, more than 50 per cent of the 130 million who comprise her live on farms or in towns of 5,000 population or less. Actually, there are less than 200 cities in the entire United States which have a population over 50,000; contract this with the 15,516 towns having a population of between 2,500 and 10,000 and under and we begin to get a pretty true picture of just where Mr. and Mrs. America really hold forth.

Let's give these people of the towns and farms the facts about roads . . . concrete, specific facts . . . facts upon which they can form their own opinions and there will be no question as to their demand.

No medium in America reaches a wider group of rural readers at the same time with the same idea than does the country newspaper. No other medium in the world can so well crystallize a cause in local terms.

General, broad information about the advantages of good roads have been read and agreed upon in the lamplighted sitting rooms of literally every rural home in the land. All this general publicity has done a splendid job. It has laid the groundwork by awaking in these people the realization of the need for more and better roads.

Translate these generalities into a nation-wide crusade for specific paved roads . . . a new road, let us say, from Smithers Corners, along the township line to the county seat . . . and then, all the nebulous advantages of good roads as a whole crystallize themselves into a meaningful and practical proposition.

The country newspaper can do just this. It is the one publication which has the greatest influence with people of the towns and farms. To them the rural newspaper is a home institution. They know and respect the editor. Local people produce it and it brings home to them in clear, everyday terms the story of better, happier living. Its reader response is hardly less than phenomenal.

COUNTY ROADS

Summary of Seven Technical Reports

By PAUL B. RYNNING
County Engineer
Jackson County
Medford, Ore.

TECHNICAL papers of the County Technical Committee were submitted to its chairman for review before being presented in order to eliminate duplication of statements. The reports presented covered the following subjects: Railroad Grade Crossings; Efficient Engineering Services Cost the Taxpayers Nothing; Low Cost Roads, Bridges and Culverts; Stage Construction of Roads; Maintenance Practice in Baltimore County, Maryland; County Engineering Organization as an Administrative Assistance to Local Governing Officials; and Studies of Equipment Depreciation.

Railroad Grade Crossings.—One of the major problems confronting highway officials in a metropolitan county is the elimination of railroad-highway grade crossings.

Cook County, Illinois, which includes Chicago, the second largest city in the United States, is the hub for all the large railroads. This county, therefore, is confronted by the serious problem of either eliminating or protecting a large number of crossings. Mr. Duncan M. Campbell, Chief Engineer, submits a report covering a study of these problems within his county. His report states that the justification for the elimination of highway-railroad grade crossings is a problem in economics.

Traffic delay was found to constitute the only tangible and representative index of the cost to the public of highway-railroad grade crossings. Careful surveys were made by the county. These surveys covered time lost to highway traffic, and special consideration was given to those crossings over which switching movements occurred and those which were blocked in the loading and unloading of passenger trains. A cost was computed for daily vehicle minutes delay. The daily vehicular delay at each crossing was evaluated and expressed on an annual cost basis. An estimate of cost was made for grade crossing separation structures. When the annual delay cost over a 50-year period equalled or exceeded the elimination cost, these projects were then programmed for construction. The priority of elimination was deter-

When These Two Columns ADD UP . . .

DESIGN

CENTER DRIVE: Turntable, crawler and shovel boom are all built to the time-proved principles of Center Drive design.

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BALANCED TURNTABLE: Patented sloping machinery frame concentrates machinery weight to develop maximum capacities at minimum weight.

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SIMPLICITY: A compact, accessible design whose fewer parts are huskier, stronger.

•

CONCENTRATED POWER: A direct-to-the-point application of power which can be concentrated all on one operation or spread over simultaneous ones. Gas, Diesel or electric.

•

MOBILITY: Two crawler speeds (and steering) in either direction. 30" wide treads available for minimum ground pressures. Travel brake.

•

CABLE OR CHAIN CROWD: Choice of independent Chain Crowd (illustrated) or automatic cable crowd.

•

VERSATILITY: Easily convertible, and equally efficient as a crane, dragline, clamshell, shovel, backdigger, skimmer-scoop.

PERFORMANCE

1200 Yds. in 10 Hours!

That's the yardage for this ¾-yd. Lorain-40A of the Smith Construction Company. The shovel is digging and loading creek bed sand and gravel for a highway job in Lincoln County, W. Va.

And here are a few more reports from Lorain-40A owners—

2508 yds. in 13 hrs.!
1600 yds. in 12 hrs.!
1800 yds. in 12 hrs.!

Sure, these are top yardages but they show what this ¾-yd. machine can do under pressure.

YOU'VE GOT A BUY

• The Lorain-40A is one ¾-yd. machine that can lay both design facts and performance figures on the line to prove its ability to move more material, faster, at lower cost. The complete story may be had by writing

UNIVERSAL CRANE DIVISION • THE THEW SHOVEL COMPANY • LORAIN, OHIO

THEW CENTER DRIVE

3/4-YD. LORAIN·40A

mined by the number of years required for the delay cost to equal the elimination cost.

The crossings not programmed for elimination were assigned an index of hazard according to a formula given in Mr. Duncan's report. These crossings were programmed for protection utilizing various safety devices.

Efficient Engineering Services Cost the Taxpayers Nothing.—Mr. Carl T. Bowen brings out the following facts:

Every engineer knows that in most localities more than one survey must need be made, involving reconnaissance, preliminary and final location. Few people know of the economics involved in the proper location of highways and bridges. The cost of one additional survey can very easily be offset by a change in the design of a road or bridge, and an additional survey may also improve the elements of safety.

Without proper engineering the road may be constructed with improper drainage structures or may be constructed upon soils which lack sufficient bearing value. Materials without the proper laboratory tests may prove expensive and the cause of structural failure. Without proper engineer's plans and specifications bridges may be installed which are inadequate in size or strength. Without proper ditching and drainage, foundations and sub-structures may fail with serious results.

Low Cost Roads, Bridges and Culverts.—Mr. Edward J. Himes defines low cost as a relative term. A low cost road means a road built for the least cost commensurate with the traffic requirements. Careful engineering and consideration of location are of great importance in low cost roads. Every road to be considered a low cost road must have adequate drainage, and, unless a road is properly drained, it is an expensive road. It is not possible to state in dollars what is meant by low cost road construction and apply it to all states or sections of the country. When a road is constructed, consideration should be given to the requirements of future maintenance. Very often maintenance can be built into the road by reason of its proper location and construction. A road which requires a high maintenance immediately after completion of construction is not a low cost road but an expensive road.

Stage Construction of Roads.—Mr. E. R. Fischer submits a report covering stage construction in Racine County, Wisconsin, and the following methods of construction have been found to be practical within that county.

The first step of stage construction is to consider the right-of-way. The right-of-way must be of sufficient width to provide for the construction of a road bed commensurate with the traffic needs, proper side drainage and beautification if necessary.

The second stage of construction is to properly grade, drain, and surface the road for year around travel, particular stress being given to road bed, width, curvature, gradient and safety.

The third stage is to maintain the road for a year or a sufficient length of time to determine whether the road has been constructed to withstand frost boils and maximum traffic, and the road bed has attained its normal settlement.

The fourth stage of construction is the paving of the roads or the application of a wearing surface. The amount of traffic and type of traffic must determine whether the road surface shall be covered with an oil or tar covering, a high type two-inch mixture or a portland cement concrete pavement.

The fifth stage, applying particularly to asphalt or tar surfaces, is the application of retread or additional seal coats.

The sixth stage is to properly maintain the road.

Maintenance Practice in Baltimore County, Maryland.—In the maintenance of the roads in a metropolitan area many problems arise. Many of the roads in Baltimore County were developed along agricultural lines with no particular thought given to alignment and grade. With the advance of the automobile it was necessary to improve existing roads to make them passable the year around. The material thing to do was to cover the roads with waterbound macadam. With the improvements of roads the suburban areas developed. With the development of suburban areas the macadam road became difficult to maintain. Asphaltic cement pavements were then placed upon the macadam roads without making any changes in alignment or grade. Traffic increased with the result that the asphaltic pavements became dangerous, because of slippery condition, high crowns, no super-elevations and sharp curves. Through a stage construction program Baltimore County gradually eliminated high crowns, built up necessary super elevations and non-skidded a great number of miles. It is interesting to note that this work has not increased the cost of maintenance, and it is expected that future maintenance and betterment costs will be lower. Mr. Herman F. Meyer, Jr., has accomplished this work not without some difficulty. To eliminate slippery roads a new type of pavement was used, and to obtain efficiency a change in organization was necessary. With the close cooperation of the county commissioners the engineer was enabled to make numerous experiments with the result that Baltimore County now has many miles of good roads with a decrease in maintenance costs.

County Engineering Organization as an Administrative Assistance to Local Governing Officials.—Mr. Frances L. Brown submits a very interesting report on this subject. One step in which the county engineer can help local governing officials is to demonstrate by his own activity his ability to handle the county road problems. Well kept buildings and well built and maintained roads are his best advertisements. With his organization and his opportunities for research and development, it should be an easy matter for him to gain the confidence of the local town officials. Diplomacy must be used. The county road administrator should be able to prove to the local officials that any suggestions that he may make will not interfere with existing financial policies and that his suggestions, if carried out, will accomplish certain objectives and will not interfere with the local organization.

The county road engineer needs the encouragement of an approving public opinion. To receive an approving public opinion he must be subjected to publicity which brings before his constituents the successful management of his office. The county road administrator will then automatically receive the confidence of the local officials, and through this confidence he will be able to instil his methods of construction and administration into those of the local governing officials.

Studies of Equipment Depreciation.—In order to have correct cost accounting it is necessary to take into consideration depreciation of equipment costs. Many counties do not charge any rentals for equipment used in the construction or maintenance of their roads. In a survey of county road management compiled by Better Roads Magazine it was found that some of the smaller counties operated as efficiently as many of the larger counties, except on a smaller scale. In the states of Wisconsin and New York most of the counties make use of revolving funds. In some states the laws prevent the use of revolving funds. It is in these states that some difficulty is experienced in charging for rentals and depreciation. Machinery is purchased from moneys budgeted for

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This one production line —set for only one size of cylinder blocks—includes 34 basic machining operations on 11 precision production machines, performing automatically hundreds of multiple operations . . . Each block is subjected to more than 32 individual inspections with precision gauges to maintain uniform quality while in process.

Four especially designed machines performing multiple precision operations on cylinder blocks—typical of the equipment on Briggs & Stratton cylinder block lines.

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Briggs & Stratton is more completely "tooled up" for the precision production of small gasoline motors than any other plant in the industry . . . and this is but one of many reasons why you can be sure of uniformly high quality in any motor bearing the Briggs & Stratton trade-mark . . . why continued performance records have earned such a reputation for Briggs & Stratton motors that they outsell any other make in the world.

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IT'S POWERED RIGHT WHEN IT'S POWERED BY BRIGGS & STRATTON

a particular year, and it is impossible to charge out a rental rate except on paper. The entire cost of the equipment is charged to operations of that particular year in which the purchase is made. Mr. Walter O. Dow has made a study of equipment depreciation and submits a report covering his studies on the subject. Rental values should include depreciation, maintenance, operation cost, over-head, interest on the investment and readiness to serve. It is difficult to ascertain the correct value of depreciation for each job. Some jobs may be very difficult and the depreciation together with maintenance may be considerable greater on one job than on another. To obtain an average cost a study must be made over a period of years, and an hourly rate or daily rate made for each various piece of equipment based upon past experience. The underlying principle of a rental rate is to build up a fund which will pay all charges against the individual machine and replace it at the end of its useful life.

Report of County Committee on Governmental Relationships

By ALAN N. BUCK
Chairman
County Superintendent of Highways
Decatur, Illinois

MUCH has been said and written concerning federal, state and county cooperation in highway problems, and in the past few years many forward steps have been taken. In cooperation with the various states and counties, through the highway planning surveys, we have come into possession of a complete and standardized physical inventory of our county systems. County systems are 57 per cent of the total public road mileage in the country, and, when taking into consideration the township roads over which there is a large degree of county supervision, we find that this includes 85 per cent, or about 2½ million miles of public roads.

If the Public Roads Administration will continue to serve as effectively as it has in the past through traffic studies and a general and impartial viewpoint in promoting sensible arrangements between state and local agencies in the proper location of local roads to be improved with federal aid it will be a valuable service. There have been too many instances in the past where federal secondary appropriations have been used for improvements without consulting the local authorities as to proper location, etc. It is to be remembered that the maintenance of these improvements so financed will be the responsibility of the same local officials and units of local government.

Counties and townships should continue to have a definite part in the construction of highways, as their participation tends to make a good balance-wheel in highway matters. County officials should, therefore, consider their county highway departments one of their most important functions in the county government. They should hire not only trained highway and bridge engineers for the investigation, survey, design and construction of highways and bridges, but should also have the highest type personnel in their county garages and maintenance crews.

The establishment of a County Highway Bureau in the Public Roads Administration would do much to enhance the value of county government from the highway angle in the eyes of the people.

It has developed during the last 6 or 8 months, and in this case I am talking about my own experience, that there are many more rules and regulations and increased sponsor contributions than has been the case previously. We have also found by cost records that a contract job which requires the same amount of man-hours as a given WPA job and on which the total cost is about the same will provide four times the mileage of highways.

We further feel that the highway administrative program, which is more or less involved today because of federal, state, and local interests in the present system of operation, is getting to be more involved and more cumbersome because of the introduction of WPA procedure into local government operations. It would seem that if possible much of the money appropriated for WPA road work should be expended directly through the Public Roads Administration.

Legislation Administration and Finance

By A. M. WILLIAMS
Engineer-Manager
Ionia County Road Commission
Ionia, Mich.

DURING the past year, the Committee on Legislation, Administration and Finance, of which I am chairman, has been making a study of the section of the federal highway act which pertains to federal aid to secondary roads. This study is being made in response to sentiments expressed at the Chicago convention by local road administrators, that the requirements necessary to qualify a road to receive this money have nullified the intent and purpose of the sponsors of the federal aid for these roads.

It is very clear after studying the act, that the word secondary may be the reason for misunderstanding and disappointments. The Public Roads Administration, we appreciate, must take the laws it reads and interpret the word secondary in its true meaning limiting the bureau to roads next in importance to the primary federal aid system. This restricts the P.R.A. so that they cannot, under the present act, meet the expectations of the local road administrators in applying federal aid to farm-to-market roads which the local administrators have foremost in their minds.

The report raises the question as to whether or not conditions have changed during the past two years and whether or not such local roads come under the National Defense Program. Inquiry has been made of the leading local road officials all over the United States and the report covers a summary of the expressions received from these people. It reviews the secondary road legislation from its inception in 1936 and the subsequent rules and regulations adopted by the Public Roads Administration. It includes the amendment which the committee passed and submitted to the convention for discussion.

Report of Committee on Organization

By OTTO HESS
Engineer-Manager
Kent County (Michigan) Road Commission

THE Committee on Organization has during the past year considered the question of a national organization of county highway officials from the following standpoints:

1. Is a national organization of county highway officials desirable or necessary?
2. What are the chief reasons for such an organization?
3. Does the County Division of the American Road Builders' Association meet the requirements of a National organization?

In order to bring out the facts bearing on these major points various members of the committee were given individual assignments to cover the various phases of the subject. The fullest cooperation of committee mem-

THE *New* INTERNATIONAL TRUCKS*

All-Truck Trucks *Better Than Ever!*

International Harvester is proud to present "The New Internationals"... beautiful in appearance, powered beyond requirements, engineered for unbeatable economy.

The heart of the remarkable economy in all the light-duty models is the new International-built Green Diamond Truck Engine...exclusively International.

The new Green Diamond Engine

The smooth performance of this power-giant, plus its sensational low-cost operation, make these new K-Line Internationals big money-savers on any hauling job.

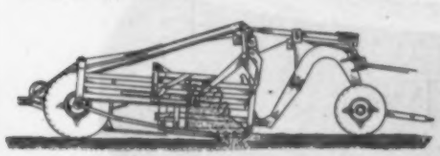
There are new double-anchor hydraulic brakes; long, easy-riding springs; sealed-beam headlights; safety glass throughout; a new all-steel Safety Comfort-Cab; and many other features.

Phone any International Dealer or Branch for a *New* International demonstration. And write for a catalog.

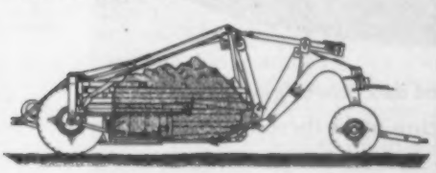
INTERNATIONAL HARVESTER COMPANY
180 North Michigan Avenue Chicago, Illinois

With LeTourneau DOUBLE-BUCKET CARRYALLS *you can* GET MORE YARDAGE from Your Tractor Power . . .

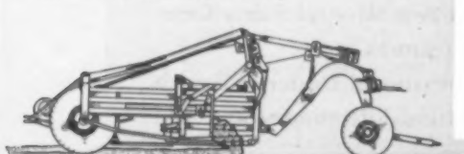
Model LU loading. This double-bucket Carryall has the same 8' 6" cutting edge as the ordinary 8 or 9-yard scraper, requires no more loading power than the normal 12 to 15-yard scraper, but has a capacity of 19 heaped yards.



Start of load—telescoping bucket in forward position. Notice that material piles up at rear of scraper bucket.



Completed load—rear bucket returns to end of scraper on roller bearings, carrying material full length of scraper.



Complete ejection—rear bucket also moves forward, with ejection tailgate wiping sides and bottom clean of all load.

Made in 4 Sizes

*LU	19 yard heaped capacity for D8 or B Tournapull
**FU	23 yard heaped capacity for D8
**RU	30 yard heaped capacity for D8 or A Tournapull
**NU	45 yard heaped capacity for D8 or A Tournapull

*8' 6" cutting edge **10' cutting edge

Reduce Loading Effort • Increase Yards per Horsepower • Proved by 4 Years' Use

You get more yardage from your tractor power because loading a double-bucket, in effect, is like loading two small scrapers one after the other. To begin loading, the rear bucket telescopes forward (see operating sketches). The material loaded into this shortened bowl travels back on rollers and roller bearings instead of being forced back. Result: less loading resistance plus a larger and better heaped load, with no empty corners.

Smart, Load-Expanding Design

The yardage you can put into a conventional single bucket scraper with 90 to 100 H.P. naturally is limited by:

1. Bowl height
2. Width of cutting edge
3. Bowl length

Practical experience has fixed bowl height at 4 to 5 feet. Shipping requirements limit cutting widths to 10 feet maximum. And, until the advent of the double-bucket Carryall, the power required to force dirt back pretty well limited bowl length. Then came the revolutionary LeTourneau double-bucket Carryall. With this revolutionary double-bucket design, you retain the same bowl height . . . can use the power-saving, narrower cutting edge of a conventional 8 or 9-yard scraper . . . yet, because power is conserved by this unique method of loading into one bowl and rolling it back, you're able to expand bowl length and increase capacity as much as 50%.

It's proved by 4 years of use by leading contractors the country over. Plenty of repeat orders show it's a profit-maker. Simple, easy to operate. Patented and available only from LeTourneau. Ask your LeTourneau-"Caterpillar" dealer to show you how a double-bucket Carryall can step up your yardage. See him NOW.

SEE OPPOSITE PAGE FOR ADDED ADVANTAGES

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PEORIA, ILLINOIS • STOCKTON, CALIFORNIA

For Lowest Net Cost per Yard-CARRYALL* SCRAPERS, ANGLEDOZERS*, CRANES, BULLDOZERS, POWER CONTROL UNITS, DRAG SCRAPERS, PUSHDOZERS, SHEEP'S FOOT ROLLERS, ROOTERS*, TOURNAPULLS*, TOURNATRAILERS*, TOURNACRANES. *Name Reg. U. S. Pat. Off.

bers was obtained and the ideas in the form of short papers received from these members do a pretty good job of answering the questions outlined above.

Conclusions.— 1. National organization of county highway officials is desirable and necessary for the following reasons:

(a) Secondary federal aid makes it necessary for counties to act as a unit in all matters relative to the administration of federal aid on local highways.

(b) National legislation affecting county highways requires unified national expression of county highway officials.

(c) Satisfactory technical progress necessitates exchange of ideas over a national scope; this can best be accomplished through national organization.

(d) Federal and state highway officials cannot be depended upon to safeguard the principles of local self-government as applied to highway administration. This matter must be attended to by the local officials themselves, and this again calls for adequate organization.

2. The type of organization, somewhat similar to the American Association of State Highmay Officials, is needed for national expression by county highfay officials.

3. The County Highway Officials' Division of the American Road Builders' Association appears to provide a satisfactory set-up for the type of organization needed.

4. County highway officials should be organized by states so that each state might be represented by an individual or small committee in a position to constantly speak for their respective states in working through the County Highway Officials' Division in Washington for coordinated action.

5. Federal assistance for local highways should be looked upon as an influence for coordinating and improving local technical and administrative progress father than a means of obtaining great financial assistance.

▼

Rural Post Roads System

By L. M. WALKER

President
National Rural Letter Carriers Association

●

IT IS often said that only 10 per cent of our population really think for themselves, thereby handicapping their personal progress. This may be true. But if thinking would solve our problem we cannot help but feel it would have been solved long ago because our members devote more than a quarter of a million hours of thought as they travel 1,392,657 miles each day and a high percentage of them are spent in concentrated thought on individual road problems.

The problem that confronts those most interested in good roads in my part of the country, that is in the roads we are discussing, "The Roads We Travel" is the ever increasing mileage being added to the part of the system embraced in what we call in Oklahoma the County Highways and the ever decreasing revenues provided for same. The decreasing revenues in our case, and I can imagine that to be true in other states and sections, is caused by a multiplicity of circumstances, such as, decreased valuations, homestead exemptions and increasing diversion. Of these we consider diversion the greatest menace and as standing on the most unreasonable and unexcusable premises.

We should consider therefore and I feel sure that we do, that diversion is our greatest single enemy, and we must direct our joint attention toward the permanent elimination of this enemy. I pledge you the ocoperation of the Rural Carriers of America in your worthy efforts in this direction.

▼

ECONOMICS

Highways America's Biggest Business

By M. McCLINTOCK

Director
Bureau for Street Traffic Research
Yale University

●

THE highway transportation system is America's biggest business in more ways than one. It is not only the largest employer of labor, the largest consumer of many basic American products, but is also the largest single source of federal and state revenues. Any thing which increases hte highway transportation business stabilizes American employment, the economic system and the financial structure of the country.

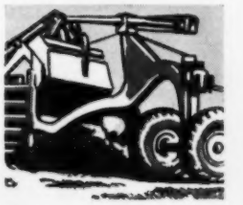
All of these contributions are of vital importance but they are quite secondary to the service which highway transportation provides to all other forms of business activity. If we were to remove the motor vehicle from American life, we would have to revert to much less satisfactory social organization and economy.

Notwihtstanding the bigness of highway transportation today, it has been throttled, restrained and handi-

You Get These Job-Proved Profit-Making Features on All LeTOURNEAU Carryalls

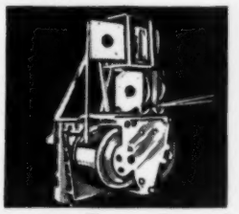
They Assure You Faster, Smoother Job Operation

1 POSITIVE EJECTION



The LeTourneau sliding tailgate operates *independently* of the apron . . . wipes the bowl clean of all material, even though it be sticky, heavy gumbo . . . enables operators to control accurately both the ejection flow and depth of spread. This tailgate design for positive ejection is expensive to build, yet the cost to you of a LeTourneau Carryall is no more than for conventional, gravity-dump scrapers of comparative size.

2 CABLE CONTROL



Fast-acting, patented 2-line control enables you to operate apron lift independently of tailgate, thus fill scraper bowl regardless of material. LeTourneau Power Control Unit is unaffected by heat or cold. More than 10,000 now in use.

3 BIGGER TIRES

LeTourneau Carryall yoke and rear frame is specially designed for big tires and has ample clearances so you can add extra tires for extra-soft conditions. Result: your tire upkeep is less, you're able to go to work sooner after rains, and can work in softer going. Only LeTourneau Carryalls are designed so you can use bigger tires or duals all around.

4 TIME-SAVING SALES AND SERVICE FACILITIES

LeTourneau Carryalls are stoutly constructed to give you long, uninterrupted service even under punishing working conditions. When repairs do become necessary, parts stocks and mechanical service are available from "Caterpillar" dealers in more than 100 cities and towns in the United States.

Only from LeTourneau do you get all these money-making yardage-increasing features.

Ask your LeTourneau-"Caterpillar" dealer to show you NOW how they can increase your profits

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capped by streets and highways which never have been and never can be an efficient medium for automobile use. We have ahead of us a nationwide program of street and highway construction. When it has been accomplished, the great unused potentials of America's biggest business will be available not only for the direct service of the users, but for the advantage of all other forms of business.

Accidents and Congestion Measure Value of Highways

By M. HALSEY
Associate Director
Bureau for Street Traffic Research

THE present situation regarding roadways may be described as follows:

(1) The great bulk of travel is now upon improved surfaces. Thus the bulk of the problem is not to get the vehicles out of the mud.

(2) The accident rate is very high and engineering methods can do much to reduce it.

(3) The great bulk of present roadways are carrying traffic at a rate of speed far below that which the public want.

(4) The economic losses due to accidents and congestion may be in excess of what it would cost to improve the roadways to a point where most of the losses would be removed.

(5) Before reconstruction or new construction can be made economically efficient, these losses and values must be evaluated so that each dollar invested will bring the greatest return in terms of movement.

Federal Debt

By DR. HOBART C. DICKINSON
Washington, D. C.

THE present plight of the world seems to be the direct and inevitable result of the way the nations involved handled the debts of the first world war. The practice was that of past ages. After the war is over this practice prevents the replacement of the tools of war by the tools of peaceful productivity and thus blocks post war recovery. Throughout the ages nations have followed this same time dishonored course, and have suffered the consequences in the universal post war depressions from which recovery often has become impossible.

This ancient war debt technique is now obsolete. A kind of floating federal debt already familiar, if changed slightly will correct this evil of post war depression, and many others. It will permit the nation promptly to replace its tools of war with tools of peace, and return quickly to a stable level of prosperity.

EDUCATIONAL

What Should Be Included in Highway Training For Engineers

By E. T. GAWKINS
Assistant Commissioner of Highways
New York State Department of Public Works
Albany, New York

THERE are different ideas as to what is the best course to follow in teaching students who are studying engineering. Some are of the opinion that major stress should be placed on preparing the student along administrative and executive lines while others believe that a good engineering groundwork should be laid so that on leaving college the graduate can start out and fill an engineering position satisfactorily, even though it does not happen to be the one that he had specialized in. Mr. Gawkins believes the latter is the better method because there are times when circumstances are such that an opportunity arises where there is an opening available that would lead to advancement in a different field than the one that he prepared in while, if he was compelled to wait for something along one certain line, he might find his progress very slow.

The administrative and executive courses should not be overlooked. One who is not fitted for the top position after he has successfully reached it would be obliged to step down and maybe out altogether. It is not practical for a student studying engineering, especially a Civil Engineering course, to specialize too much in any one part because, in most cases, the graduate will not be able, upon leaving college, to find available a position that will meet up to his liking.

Transportation on highways as well as railroads is a very important course. Highways are just as important in reference to transportation as railroads.

A good course in bridge design is beneficial to every engineering student, whether he ever intends to join a state highway force or not. A good groundwork should be laid while one is in college.

What Is the Job Of a Contractor's Engineer and What Things Should He Know

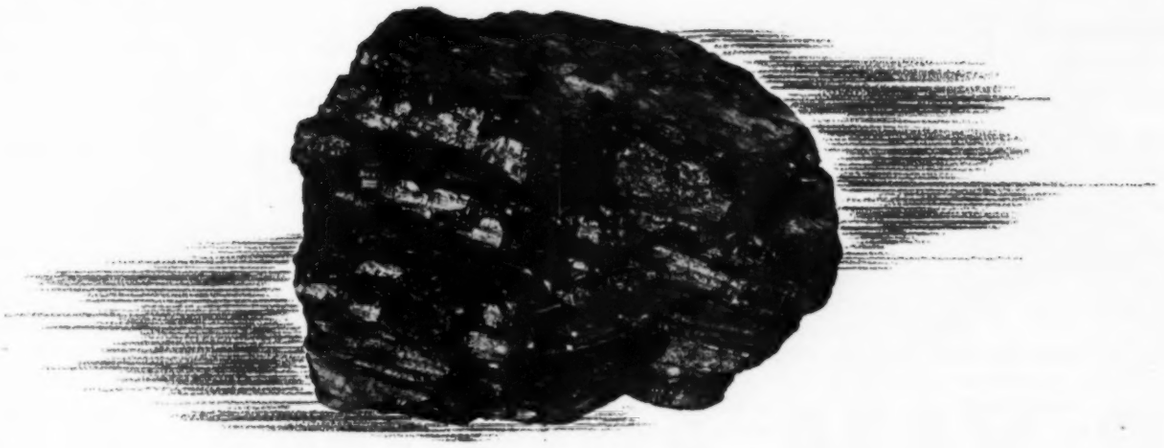
By A. E. O'BRIEN
Executive Secretary of the Associated Pennsylvania Constructors

IN HIS talk at the Educational Clinic, Mr. O'Brien developed the duties of the contractor's engineer, scheduling them under the heads of estimating, construction and cost accounting. The role of a university in providing the young engineer with the knowledge required for successful employment with a contractor formed the concluding part of the address and was the subject of lively discussion following the submission of Mr. O'Brien's paper.

The paper developed the necessity of the contractor's engineer being able to interpret and apply specifications and have a thorough knowledge in addition of the technical reasons underlying them. Another desirable feature of the equipment of a prospective contractor's engineer is a knowledge of basic economic and social laws. These latter are called into play frequently in labor relations and social legislation now surrounding many contractor's operations.

Mr. O'Brien concluded with the following remarks: "I think the college of today should instill into the hearts of their students qualities of character, good sportsmanship and gentlemanliness. These will mark the engineering graduate who is going to climb the ladder of success in his chosen field. He is going to be a good mixer among men and his presence will be welcomed in responsible groups who plan and execute large construction. It will develop in the young graduate, qualities of leadership, courage and fair dealing which is always required for outstanding success.

"If the engineering colleges do not learn to build character into their graduates, they are, to use a common phrase, 'Missing the Boat.' We are seeing today, more and more, that technical development and training do not make great nations. No one can doubt Germany's efficiency and proficiency, but certainly no one can admire the place she is taking in civilization today. A nation is no greater than its people. To my mind, character training therefore, today more than ever, demands a place in the university curriculum.



In these days—would you try a coal with 75% more B.T.U.'s?*

Speed—economy—safety—are basic essentials to American industry today. If you could find a coal with 75% more BTU—you would be glad to pay a premium to get it. Because it would give you more steam, power, economy.

**British Thermal Units*

THERE ARE EQUALLY GOOD REASONS TO TRY HAZARD LAY-SET *Preformed*

Extreme resistance to fatigue (which means longer life for wire rope) is an inbuilt quality in LAY-SET. The preforming process, through which it is passed at the mill in Wilkes-Barre, sees to that. But not only does preforming make Hazard LAY-SET give much longer service, but it makes it resist kinking, makes it handle easier and faster, makes it safer for workmen to handle. And there you have the basic essentials of speed, economy and safety.

For longer rope life, fewer machine shutdowns, increased production, reduced injuries to workmen—specify Hazard LAY-SET Preformed Wire Rope. All Hazard ropes identified by the Green Strand are made of Improved Plow Steel.

HAZARD WIRE ROPE DIVISION • WILKES-BARRE, PENNSYLVANIA
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The Employment of the Recent Graduate in the Highway Field

By W. W. MICHAEL
Associate Professor of Civil Engineering
California Institute of Technology

FOR some reason or other employment in the highway field has not been so attractive to the young engineering graduates as it has been in other fields of engineering. Just why should this work not attract?

The salary scale is comparable with that in other fields, while hours of employment are certainly no more arduous than those of any other engineering work.

There is opportunity for recent graduates to enter the field through various mediums, some of the more common ones being: state, county, and city highway departments, road contracting companies, road machinery manufacturers, road materials companies, road oil producers, and others.

In his very able paper presented at the San Francisco Convention of the American Road Builders Association in 1939, Professor Earl C. Thomas of Stanford University brought forth the idea that one of the contributing factors of the unpopularity was over-standardization. Although this is undoubtedly one of the main reasons, yet it would appear that there are other less tangible ones.

The question now arises, if employment in the highway engineering field is so unattractive, what can be done to remedy the situation?

It would appear that if competent engineers are to be attracted to the highway work, and that if we are to make the necessary progress to keep abreast of the demand for improved roads, some better co-operation should be formulated between the classroom and the actual highway work.

PLANNING

Regional Planning and Its Relation to Road and Street Planning

By HAROLD M. LEWIS
Chief Engineer and Planning Officer
Regional Plan Association, Inc.

HIGHWAYS have formed the groundwork of city plans. As a metropolitan region is an overgrown city, it is logical that highway proposals should take a major place in regional plans for such areas. Highways, however, are but one element in a transportation plan and transportation is but one element in a regional plan. A coordination of highways with rail, water and air transportation should be a major objective of regional planning.

An adequate system of express highways is essential in a metropolitan area. Some of these should be in the form of parkways limited to passenger vehicles, and others as limited access highways or "freeways" for both passenger cars and commercial traffic. Both types should be free from grade crossings or left-hand turns so far as practicable. Both will use common crossings over major waterways and may well use common approaches to such crossings through urban areas.

The highways in a regional plan may be classified by relative importance, on the basis of a geometrical diagram, or by types of use. The need of bypass highways around separate municipalities is a well accepted principle in the laying out of state highways. Belt highways in a regional scheme should include both an outer belt, as a metropolitan bypass, and near-in belts. The latter will serve primarily for the interchange of traffic between radial routes so far as to permit a vehicle to enter or leave the central areas by the most direct route.

A regional highway is incomplete unless it makes some provision for handling the automobile terminal problem in the central areas. Otherwise wide radial routes will only aggravate the congestion in these areas. Adequate parking spaces and facilities for off-street loading and unloading must be considered a part of the highway system. Public agencies must assume some responsibility for solving this terminal problem.

At the present time national defense is uppermost in everyone's mind. Planning our highway systems on a regional basis will certainly promote the defense of our metropolitan areas. The most available emergency transport will obviously be by automobile for we have enough motor vehicles to transport at one time our entire population. It is equally obvious that the concentration of such vehicles in an emergency will create hopeless confusion unless it is well planned in advance.

Planning in Monroe County, New York

By J. F. BONNER
Director
Monroe County (New York) Division of Regional Planning

COUNTY planning in Monroe County, New York, is considered a research and fact finding job. The Division of Regional Planning is the research branch of a municipal business capitalized at $650,000,000 with a gross budget of approximately $9,000,000 annually. Operated by a County Manager, appointed by a Board of Supervisors consisting of 43 members (directors).

During the past several years the activities of the division have been materially increased through the assignment of personnel from the various emergency work relief agencies. During this period the funds allotted to planning have amounted to from 0.1 of 1 per cent to 0.4 of 1 per cent of the county budget.

In order to achieve a program, analysis of the problems comprising the interelated physical, social and economic life of the community are necessary.

In making these studies the standard procedure for planning research is followed:

1—Providing basic maps.
2—Gathering and analyzing facts and data.
3—Developing plans so as to use the resources of the community to best advantage.
4—Educating local administrators and the public as to the practical value of planning.
5—Keeping abreast of changes in Social and Economic conditions.

In approaching the task of physical mapping it was found that sufficiently accurate and up-to-date maps were not available. The mapping program has provided:

1—Aerial mosaics of the County scale 1/12000.
2—A new U.S.G.S. scale 1/24000 5 ft. contours.
3—A new Soil Map at the same scale.
4—A Bed Rock Contour and Water Resources Map scale 1/24000.
5—Property boundary maps for the 70,000 parcels of land in the 19 Towns and 10 Villages, scales 1/1200 and 1/12000.

The fact finding surveys were organized to provide an inventory of past and present conditions so as to meet not only the needs of normal governmental operation but also emergency conditions of either peace or war.

Highways and Traffic.—1—Detailed Traffic survey and annual count to indicate trends.

2—Traffic accidents, study of density. The work of the Sheriff's Office in studying details of accidents. Removal of physical causes of accidents.

3—Found that in Monroe County outside of the City

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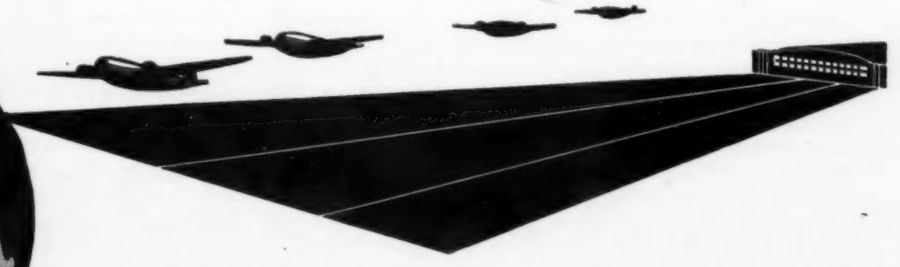

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of Rochester there were few problems of traffic movement. Practically all of congestion and delay was due to the lack of adequate storage or parking facilities.

4—Relationship of vacant, obsolescent tax delinquent properties and the use of their sites for off-street parking.

5—Also the use of such properties for the opening of dead end streets and by-pass highways. In one instance 139 parcels of the 151 necessary for a by-pass have been foreclosed and are being reserved.

Studies of Towns and Villages.—Studies have been completed and reports published dealing with financial, economic, and social organization and operation of the 19 towns and 10 villages of the county for the past 25 years period. These reports show among others:

Population, total, density and movement, assessed valuation, receipts, expenditures, delinquencies, debt, bond retirement schedules, school organization and cost of operation, public buildings and capacities, churches, industrial units, power and pipe lines, social organizations, fire fighting units and other related information. In these town and village planning inventories are included maps showing the highways (maintenance, width, type, bottle-necks, size and capacity of bridges and culverts, accidents, etcetera). Location of schools and boundaries of school districts, location of public buildings and sewers, water lines, housing density 1900 and 1939, soil productivity, slope of land, watersheds, stream pollution, zoning and others.

Cost of overdevelopment during the 1920's is now being paid for by the taxpayers of the county. The annual cost of overdevelopment is nearly equal to the annual cost of relief. Practical planning would have prevented a large portion of such overdevelopment.

Planning as a research process and as practiced in Monroe County makes possible a program of action leading toward a better relationship among the uses of land. Agriculturally toward a better biologic balance of crops and animals, socially toward balance in areas for business, work, residence and recreational uses and economically toward a balanced budget.

Present Status of Highway Planning Surveys

By H. E. HILTS
Assistant Chief
Division of Highway Transport, Public Roads Administration

SINCE the highway planning surveys were started late in 1935, 46 states in cooperation with the Public Roads Administration of the Federal Works Agency have completed, and two states have well under way, an inventory of their rural road systems, a complete count of the annual traffic over these roads, and a study of the ways and means by which they are to be kept up to meet the needs of the road users.

Although the major task of collecting the preliminary information has been done, the work has not ended. Each state has recognized the importance of keeping the data current and up-to-date, and has accepted it as a continuing function of its highway department. By constantly adding to and checking the fund of information made available by the surveys, the state highway departments find themselves in possession of accurate factual data which permits better planning, more efficient administration, the relief of traffic congestion, and safer travel.

The most timely contribution of the highway planning surveys has been the determination of a strategic system for national defense, composed of those roads which are most important, in time of military emergency, in maintaining adequate transportation for the needs of the armed forces as well as the civilian population.

The surveys have also greatly facilitated the extension of the Federal-Aid System of highways by providing the data necessary for the selection of appropriate routes to be included in the Secondary Federal-Aid System.

Included in the present highway planning program of many of the states are studies of the behavior of drivers, highway capacity, and the performance of trucks on grades, which will tend to promote more efficient use of the roads and to decrease the number of traffic accidents —the goal of every road builder.

Street Planning

By N. L. SMITH
Consulting Engineer
Advisory Engineers to the Commission And Memember of on City Plan of the Board of Baltimore

SINCE the release of the report "Toll Roads and Free Roads," due to the national defense program, Baltimore's problem has become more than ever acute. Located within twenty-five miles of the center of the city will be found Army and Navy posts at Fort Geoge G. Meade, Edgewood Arsenal, Aberdeen Proving Grounds and Curtis Bay Ordnance Depot. Also within the same area the Sparrow Point plant of the Bethlehem Steel Company and the airplane factory of the Glenn L. Martin Company. The activities at these points are today employing about 100,000 men. And Washington, the Nation's Capital, is only forty miles away.

The construction of a modern highway from Washington to Boston has long been considered of great importance from a standpoint of national defense, as well as on the basis of its value to the states and cities through which it would pass. Such a highway would have a total length of about four hundred and fifty (450) miles. And yet such a road would pass through or adjacent to ten cities having a combined population within their corporate limits of over 10 per cent of the total population of the United States. And intervening urban and suburban areas add materially to this total.

The real problem in the construction of such a highway naturally occurs at the large centers of population. Again using Baltimore as an example, several schemes have been proposed to carry traffic from one side of the City to the other. These schemes which have received the most consideration are: (1) a bypass around the Western and Northern suburbs entirely outside the City Limits; (2) a route bypassing the central business section to the South, passing through the industrial section, crossing the Patepaco River by a high-level bridge or a tunnel and traversing the Eastern residential and business areas; and (3) an elevated highway connecting with U. S. Route 1 at Wilkens Avenue and Monroe Street, passing directly along the edge of the central business district and terminating at its intersection with U. S. Route 40 at Fayette Street and Broadway.

Naturally, the question of cost is all important. The suggested bypass, being entirely outside the City Limits, would not involve the City to any extent. But the other schemes are all very expensive and their financing would provide a major problem. Scheme 2 is the only plan which could be made self-liquidating by the collection of tolls.

Many factors enter into the planning of streets in the suburban areas, foremost of which is the trend of population. As an example, let us consider the public school situation. New and modern facilities for elementary and high school training are constantly in demand. And these facilities should be located at points where they are accessible to the greatest number of pupils.

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Shovel No. 3	No	No	No	No	No	Yes	No	No	No	No	Yes	No	No	Yes	Yes	Yes	No	Yes	No	No	No	No	Yes	
Shovel No. 4	No	Yes	No	No	Yes	Yes	Yes	No	Yes	Yes	No	No	No	No	Yes	No	No	No	No	Yes	No	No	No	
Shovel No. 5	No	Yes	No	No	No	Yes	Yes	No	Yes	No	No	No	Yes	Yes	Yes	Yes	No	No	No	No	No	No		
Shovel No. 6	No	Yes	Yes	No	No	Yes	Yes	No	Yes	No	Yes	No	Yes	Yes	No	Yes	Yes	No	No	Yes	No	No	No	
Shovel No. 7	No	Yes	Yes	Yes	No	Yes	Yes	No	Yes	No	No	No	No	No	No	No	No	Yes	No	No	No	No		
Shovel No. 8	No	Yes	Yes	No	No	Yes	Yes	No	No	No	No	No	Yes	Yes	No	No	No	No	No	No	No	Yes		
Shovel No. 9	No	No	Yes	No	No	No	No	No	No	No	No	No	Yes	Yes	No	Yes	Yes	No	No	Yes	No	No	Yes	Yes
Shovel No. 10	No	No	Yes	Yes	Yes	Yes	No	No	No	No	No	No	No	Yes	No	No	Yes	No	No	No	No	No	No	Yes
Shovel No. 11	No	Yes	No	No	Yes	Yes	Yes	No	No	No	No	No	No	Yes	Yes	No	Yes	Yes	No	Yes	No	No	Yes	Yes
Shovel No. 12	No	Yes	Yes	No	Yes	Yes	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes	No	No	No	No	No	Yes	Yes

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Having assembled the necessary data to determine the center of school population, the matter of transportation facilities must be seriously considered. Pupils reach school on foot, by private cars and by public conveyances. Since there has been little or no expansion of street railway tracks during the past several years, this means of travel is limited to existing lines. But passenger bus lines are being extended into areas capable of producing an adequate pay load and these buses naturally require suitable streets and highways.

When a developer undertakes the subdivision of an area, he naturally wants to erect as many homes thereon as possible, as his profit is in the land itself rather than in the building. It is, therefore, natural for him to hold the width of streets and alleys to a minimum. Nearly every home owner has one or more automobiles, and he considers it his privilege to park in front of his house. When he entertains, ihs guests require parking space also. The result is that there is no room left for moving traffic.

When this condition arises, the city officials have one of two solutions: the restricting of parking to one side only or the restricting of traffic to one direction only. In either case, someone is inconvenienced, and the action is protested by the sufferer. How much better off everyone would have been if the street has been paved sufficiently wide to permit a free flow of traffic in both directions.

The street planner is, therefore, vitally concerned with the educational program of the city and its coordination with population trends. He is likewise interested in recreational facilities for people of all ages, and this includes the small playground as well as the large stadium. And he must consider all the other angles incident to the health, convenience and safety of the suburban residential population in planning new highways or modernizing old ones.

Undoubtedly, the express highway, with grades separated and access reads provided at proper intervals, is the best solution to expediting traffic, but the cost of providing such facilities in enormous.

Another problem to be considered is the disposition of automobiles during the day. Whose province is it to provide parking facilities for the office worker who drives to work every day? And also for the shopper who may wish to spend only a few minutes, or perhaps several hours in one or more stores or markets? Certainly the city is not obligated to provide such space. It may help the situation by requiring that when a new store or office building is erected, it shall provide facilities for a proportionate number of cars, but such a requirement would in most instances, necessitate the purchase of additional property and the demolition of buildings which are producing revenue.

To the planner and engineer engaged in the task of making his city a better place in which to live and work, Mr. Smith summarized his paper by the listing of a few "Do Not's":

Do not let your suburban developer, in his effort to get a maximum return for his land, fail to provide ample street facilities.

Do not permit the satellite shopping centers to converge on the main arterial highways and hamper the movement of traffic.

Do not allow the natural beauty of your stream valleys to be destroyed when they lend themselves so admirably to parkway development.

Do not plan your additional suburban arteries to feed into existing overcrowded highways without some provision for handling this additional load.

Do not approve the expansion of your highway facilities without carefully assembling and analyzing the traffice of today and its projection into the future.

Do not ignore the planning of other facilities in your desire to get better traffic conditions.

Do not project an elevated or depressed highway through town without considering its effect on the area through which it passes.

And, lastly, do not overlook the fact that the results of any type of improvement must justify the expenditure involved. A balanced budget, a reasonable tax rate and a proper debt limitation may defer the consummation of desired improvements, but it is better to spend two or three more minutes going to and from your office than to impose a debt upon your City which will endanger its credit and place an unnecessary burden upon future generations.

MUNICIPAL

Practical Improvements of Traffic Conditions in Urban Communities

By H. F. ILGNER
Chairman
Traffic Committee
Milwaukee (Wis.)
Safety Commission

URBAN communities are confronted not only with a motor vehicle traffic problem but also with a pedestrian traffic problem, which, from the standpoint of traffic safety, many times overshadows the motor vehicle problem. While education and enforcement are most important, the ultimate goal must be the elimination of conditions which are fundamentally unsafe. Traffic which is in conflict must be separated by insulating the traffic moves in order to produce conditions where safety is easy and natural. Grade separations on a large scale are out of the picture for the average urban community, so other simpler and less expensive methods must be resorted to, namely, channelization and proper timing.

The timing of traffic flow is usually accomplished by traffic signals interconnected with adjacent installations. The desired objective for vehicle traffic is usually considered to be a continuous progressive movement with minimum interruptions. But such progressive vehicle movement on streets with two-way traffic produces a condition at intermediate intersections between the signalized intersections which is most disastrous for the pedestrian, inasmuch as there is vehicle traffic moving in one or the other or both directions all the time. The regulation that the pedestrian shall have the right-of-way from curb to curb on all crosswalks at unsignalized intersections becomes an impossibility with progressive timing. Even at signalized intersections the regulation that a pedestrian starting to cross a street on the green light has the right-of-way to the opposite curb many times is just a myth. The signal changes while the pedestrian is half-way across the street, and immediately the traffic in the opposite direction jumps forward.

The use of channelizing islands, however, makes it possible to produce conditions which are reasonably safe for a pedestrian without interfering with the movement of vehicular traffic. By proper coordination and cooperation between traffic engineering and street construction, such conditions can be brought about at relatively reasonable costs. When streets are repaired or repaved or roadways widened, an opportunity presents itself to incorporate into many intersections practical improvements which will not only produce greater safety but also greater facility.

If all such opportunities on every possible occasion are

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We don't know when this catalog was shipped to Argentine, but on July 11th an air mail letter was sent from one of the largest industrial machinery distributors referring to the advertisement of the SEAMAN PULVI-MIXER and stating that our MIXER would apparently fit in well with the stabilized road program which the National Highway Department is considering.

The response that we have had as a result of this "ad" indicates that you are reaching the people in the highway market and that your pages are eagerly scanned for new, as well as labor and time saving equipment.

We are satisfied that the advertisement of the SEAMAN PULVI-MIXER in "Powers Road and Street Catalog" will prove a most profitable investment.

Very truly yours,
SEAMAN MOTORS
by A. W. Giersbach
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taken advantage of year after year, it is surprising what progress can be made. We have indeed been fortunate in Milwaukee to have established such cooperation, with results that—while not phenomenal—have, nevertheless, over a period of years been encouraging.

Some of the problems which have confronted us and the solutions arrived at to improve conditions will be shown on the screen, which will make them more easily understandable and which, with a short explanation, will enable you to visualize the results obtained.

Correcting Traffic Jams at Municipal Borders

By GEO. M. SHEPARD
Chief Engineer
Department of Public Works
St. Paul, Minn.

IN view of financial and physical difficulties in widening streets, and in the larger cities of building high-speed express highways fast enough to take care of increased traffic, the matter of relieving congestion at municipal borders and within metropolitan areas, is a timely one for the consideration of this Association. The report of the Bureau of Public Roads on "Free Roads and Toll Roads" gives the first authoritative recognition of municipal traffic problems by federal and state authorities.

Local streets of cities constitute 6 per cent of the total road and street mileage and serve approximately 30 per cent of the total traffic of the nation expressed in vehicle miles. While apportionment of gasoline tax and license funds gives a few cities adequate means for street construction, generally speaking the improvement of local city streets is not part of the general highway plan. Financial burdens of cities in recent years makes it impossible for them to reconstruct streets with the existing municipal tax or assessment structure.

From the physical standpoint, much can be done to remedy the existing situation of traffic congestion without acquiring the right of way necessary for more extensive improvements. Many streets can be improved quickly by resurfacing or removing the worst difficulties and made safe for substantial volumes of traffic.

Summary of Recommendations.—(1) Expand the traffic handling capacity of trunk highways in municipalities by extending the benefits of the federal aid secondary system to reconstruct and pave existing local streets without expensive right of way widening.

(2) Include lighting, signs, traffic control signals, channelizing, etc., as well as street construction, as being eligible for aid in the proposition listed in (1).

(3) Provide adequate marking for such local streets as are used for alternate or by-pass routes.

(4) Where improvement of existing width streets will not suffice to eliminate traffic congestion, improve existing trunk highways by widening with federal or state highway funds, or the creation of limited access express highways into the municipality.

Any plan of highway development which will correct traffic jams at municipal borders will unquestionably be of benefit to transportation used in national defense. The construction of adequate alternate or parallel roads using existing local city streets is of particular value. Several parallel roads with adequate bridges and roadway widths are necessary for the movement of mechanized forces. The alternate or parallel secondary roads herein proposed might under certain conditions be required to carry the entire local traffic should trunk highways be restricted entirely in time of emergency to defense uses.

Engineer-Lawyer Relationship and the Expert Witness

By F. J. KELLY
General Counsel
American Road Builders' Association
Washington, D. C.

IN HIS remarks, Mr. Kelly pointed out the confidences that should exist between engineer and lawyer on a case. Cooperative spirit will produce best results.

In speaking about the expert witness he said that the first question which arises in a discussion of a case where expert witnesses might be used is whether or not the subject matter is one which is fit for the admission of expert testimony.

Speaking generally, opinion evidence is inadmissible in court. Witnesses must testify only to facts and from a recital of the facts the jury or other fact-finding body must draw a conclusion. There are certain types of cases, however, where a mere recital of the facts would leave the jury in a hopeless maze because the subject matter is far beyond the comprehension of the average juror. In this type of case opinion evidence such as expert testimony may be received. Engineering questions are peculiarly fit for the admission of expert testimony since a mere discussion of the conditions would not enable the jury to draw an intelligent conclusion. The jury needs the advice of persons who by virtue of training and experience are skilled in that field and who from a discussion of the facts are capable of drawing an intelligent conclusion. The jury need not accept that conclusion, but the theory is that the expression of the conclusion by an expert will be helpful to the jury. It is for the Court (and by this is meant the judge) to determine as a preliminary matter whether or not the subject matter is one fit for the admission of expert testimony.

Who may testify as an expert? This is another preliminary matter for the Court and every witness who is offered will be thoroughly interrogated by counsel for both sides in an effort to convince the Court of his qualification or lack of qualification as an expert. If the Court finds that the witness who is offered has by reason of his education, training or experience a sufficient knowledge of the subject matter under discussion he will be admitted to testify as an expert. The lawyer who offers this witness has a dual purpose in asking background and experience questions. (1) He must convince the Court of the qualifications of his witness, and (2) he wants if possible to convince the jury that this witness is the best in the field because the WEIGHT of the expert's testimony is for hte jury. Before the witness is qualified he is subject to cross-examination by opposing counsel. If opposing counsel knows that the witness is one of the best in the field he may admit him before the offering counsel has gone into his qualifications. The purpose of this is to keep from the jury a recital of his good qualifications so that when deliberating the case the jury will not place undue weight on the testimony of that particular witness. In most jurisdiction, however, the offering counsel is privileged to go into the matter of his witness's qualifications even though opposing counsel admits him.

Supposing that the expert is qualified he is now interrogated by his counsel on the subject matter. Unlike the ordinary witness the expert may state conslusions. He may state that the wall is unsafe—the ordinary witness could merely tell about the wall and have the jury determine whether or not it is unsafe. The expert may testify either from a personal examination of the subject matter or through the use of the hypothetical question. A mining engineer may examine a site and testify that the site contains so many tons of coal. Mind you, he is not stating a

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Whatever the urgency of your airport program, remember that the runways, taxiways and aprons you build today must serve heavy planes for years into the future and do so safely and with minimum upkeep. Why take chances with inadequate, short-lived surfaces costly to maintain, when actual figures show that concrete is more economical?

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● Improvements at Wayne County Airport, Detroit, are under supervision of Board of Wayne County Road Commissioners; Leroy C. Smith, Airport Manager and County Highway Engineer.

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fact, but merely an opinion but being an expert he is permitted to do so.

The hypothetical question is a familiar method of interrogating the expert witness who has made no personal examination of the site. A very long and sometimes complicated question is propounded to the expert based on a series of assumptions and from the facts assumed the expert is asked to give his conclusion. Everything assumed has, however, already been testified to by other witnesses. Remember that he is stating his opinion only, and that the jury may or may not accept it. On cross-examination he may be asked to explain in detail just what the hypothetical question was. Now unless he has studied it carefully he may be unable to do so and his credibility thereby attacked. You as a witness who will testify with the use of a hypothetical question should insist that the question be given you a sufficient time before trial to fully familiarize yourself not only with the question but also with the engineering problems involved. The opposing attorney may ask you to remove some of the assumptions and add others in order to test your reliability. A familiar method of attacking the credibility of the witness is to ask him if he is being paid. Don't squirm under this question—answer it unhesitatingly and state the amount. The judge will instruct the jury that you as an expert have a right to be paid. Beware the case where your fee is made to depend on the outcome of the litigation. Not only is such practice unethical but once it is paraded before the jury there is painted to the jury the picture of a person coloring the truth because of financial gain to himself.

Too much stress cannot be laid on the propostion that the jury weighs the evidence. They are the sole judges of the facts so you've got to convince them of your reliability. Not only must "you know your stuff" but you've got to be able to put it over. You as an expert must have both—you must be a salesman. Don't let the opposing attorney draw you into a quarrel with him. He may want to do this to make himself look silly, but he may make you appear like a smart engineer who is taking advantage of a poor lawyer. Everyone favors the underdog and jurors are no exception.

▼

Report of Committee on Elevated Highways

By V. G. IDEN
Chairman, Secretary
American Institute of Steel Construction

●

THE REPORT presented a study by Ralph R. Leffler, Chief Structural Engineer for the Sanitary District of Chicago. While this study is based upon conditions existing in Chicago it will be noted that the conditions, the arguments and the conclusions, are such as might conceivably apply to most any city.

Briefly presented, the problem is: To determine the best pattern for adequate roadways for autos and buses from the outskirts of the built-up areas to convenient parking in the inner parts of the Central Business District of a typical or near-typical "Big City". "To convenient parking" is particularly mandatory.

Mr. Leffler gives the answer to the problem as follows:

1. Two-deck elevated highways on columns on about every third north-and-south street in the Central Business District; buses on the two lanes of the lower deck and autos on the three lanes of the upper deck, one-way traffic in all five lanes; parking in the second to eighth stories of office buildings or in multi-storied garages by direct connections to the two decks of the elevated highways. No ramps to the street level in the Central Business District.

2. Two two-deck, five-lane elevated highways on columns encircling, in rectangular pattern, the Central Business District well out beyond its borders; on the outer circle the direction of the one-way traffic to be counterclockwise, on the inner circle to be clockwise. The two circles are to be about 400 feet apart. Plenty of ramps to ground surface.

Also, if needed, a circumferential superhighway, having about a three-mile radius, interconnecting the superhighways radiating out from the Central Business District.

3. Connected with and extending radially from the rectangular encirclement of the Central Business District to the outskirts of the city, five-lane elevated highways on columns, in rights-of-way 104 to 396 feet wide improved as playgrounds, wooded areas, etc. To avoid overwide subterranean effects, deleterious to the use of the ground surface of the right-of-way, none of the elevated structures shall be over three lanes wide and they shall be separated from each other by a minimum width of 34 feet clear from earth to sky. Ultimately, there may be as many as three of these three-lane-wide structures per superhighway (totalling thirteen lanes); one (preferably two-deck) for outbound traffic, one (preferably two-deck) for inbound traffic, and one (preferably one-deck) for peak-load inbound traffic in the morning and peak-load outbound traffic in the afternoon, thus providing eight lanes in the direction of the peak-load traffic and five lanes in the opposite direction. However, initially, not all of the thirteen lanes need be built; perhaps it will be found advisable to first build the three-lane one-deck structure reversible twice each day as to direction of traffic; or perhaps it may be considered to first build a five-lane two-deck structure (three lanes on the upper deck for autos and two lanes on the lower deck for buses) for outbound traffic, a similar structure for inbound traffic and to defer building the three-lane one-deck structure, reversible as to direction of traffic, until forced to build by a tremendous volume of traffic. Just enough ramps up from and down to the street surface.

▼

Traffic Accident Expectancy

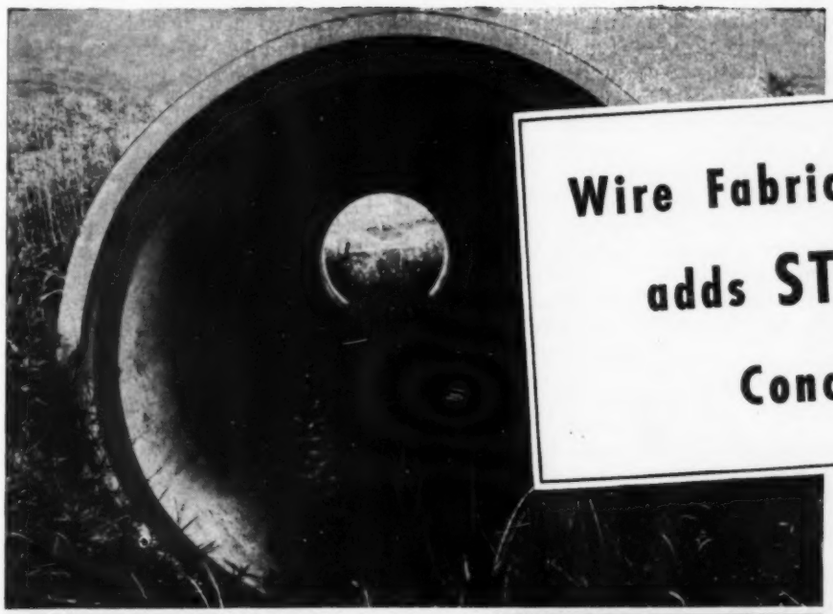
By WILBUR S. SMITH
Bureau for Street Traffic Research
Yale University

●

ACCIDENT records provide the basic factual data used in practically every major safety program now in effect, yet questions are seldom raised concerning the validity and accuracy of these records.

It is generally agreed that the two common measures of "roadway service" are safety and efficient movement. With safety established as one element of highway service, it is essential that the part played by the various roadway components in accident occurrence be determined and analyzed.

It is natural to assume that accident frequency varies with exposure. Exposure in this case includes such things as volumes of other vehicles, frequency of grade intersections, highway width and alignment, surface type and conditions, frequency of exposure to contact with other vehicles, (a measure of speed), etc. Some of these factors have been previously used in computing accident rates for comparative studies, but there is serious disagreement as to which factors should be included. By obtaining a large number of samples from selected parts of the country, it should be possible to develop, on an empirical basis, figures indicating causal proportions contributed by each of these factors to the actual record of a given highway. From this it would, for example, be



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possible to determine the reduction in accidents that could be expected to result from certain highway improvements, such as the elimination of grade intersections. An empirically developed figure of this type showing the effect of various roadway and traffic conditions on motor vehicle accidents will be called accident expectancy.

Through the cooperation of the A.R.B.A. Committee on Analysis of Accident Data, the necessary facts were obtained from twelve states for use in the analysis and calculations involved in the report. These twelve samples were all on two-lane highways representing approximately 10,000 miles with traffic volumes ranging from as few as ten cars per day to as high as ten thousand cars per day.

In the analysis, the following graphic studies were made:

1. Accident vs. vehicle miles.
2. Vehicle mile rates vs. traffic volumes.
3. Intersection frequency vs. volumes.
4. Intersections vs. accident rates.

From these analyses the following significant conclusions were drawn:

1. A linear relationship exists between accidents and travel, expressed in vehicle miles, under normal traffic conditions on two-lane highways.

2. Accident mileage rates fluctuate slightly for different traffic volume groups. The rates are slightly lower for the small and high ranges than for the intermediate volume. But the difference is not as great as had been previously supposed.

3. Curves showing the relationship between vehicular volume and mileage accident rates do not necessarily go through the origin.

4. Dispersion of accident rates are so great in the lower volume ranges that other corrections are obviously necessary if this index is to be used for comparing low and high volume roadways.

5. Except where very unusual physical and traffic conditions are encountered, the accident rate is practically constant for intermediate and high volumes normally found on two-lane roadways.

6. The results suggest that it is inaccurate to calculate the accident rates for a locality with predominantly low volume conditions on the basis of vehicle miles alone.

Strong recommendations were made that the Committee on Analysis of Accident Data continue the investigation during the coming year with the aim of developing specific accident expectancy figures. The other aim of the study will be to develop a composite rate that will take into account the various highway factors that have been discussed in the paper. It would provide a new and more accurate method of evaluating and comparing accident rates or safety on different roadways, in different locations, or states.

▼

AIRPORTS

Airport Grading, Paving and Drainage

By W. M. ALDOUS
Chief, Soils Paving Unit
Civil Aeronautics Administration

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WITH respect to grading and earth work operations, particular stress is placed upon initial preliminary soil study and classification to permit planned disposition of the natural material. Attention is directed to the imperative need of controlled moisture and density in fill construction particularly made necessary due to the need of rapid completion of airport facilities included in the scheme of National Defense.

Drainage studies and methods of making them in both field and laboratory are covered in considerable detail. Observations of rainfall and runoff from measured plots, under actual field conditions, are advocated as a desirable long range method of accumulating data. Explanation of laboratory studies now under way to provide comparative data on soil permeability and infiltration capacity is included. Advantages of promotion of surface flow through controlled grading of outlying field areas and utilization of temporary ponding in collection basins are stressed.

Paving discussion is confined to reason for need of study of applied loads over contact area of airplane tires and stress distributions in underlying surface, base and subgrade. Explanation is made of the effort of such studies as they will control use of various materials and methods of construction. A short motion picture of a newly developed portable soil pulverizing unit, particularly necessary in soil preparation prior to stabilization with various admixtures, was shown and need for such initial preparation was stressed.

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Outlook for a Nationally Integrated Airport System

By GILL ROBB WILSON
President
National Aeronautics Association
Trenton, N. J.

●

ANY SYSTEM of transportation becomes universal and proportionate in volume to its competitive economic ratio. A major basic cost of surface transportation lies in the purchase, development and maintenance of right-of-way. From this vast frozen, capital investment, air transportation will be comparatively free. Over the span of time this freedom will be strongly reflected in tariffs. The development of even the most adequate of nationally integrated airport systems will be as nothing in comparison to any given surface system. The cheapest investment any modern nation can make in the development of air power is in a comprehensive airport system.

Inevitably, the economic foundation of any system of transportation will rest in cargo. The travel of man himself will always be static but his demands for a higher standard of living keep transportation pressing into new territory, toward greater speed, into greater economies. The airports of the future will be loading platforms of commerce. Much of the present super-speed fatio of the aircraft to surface agencies can be translated into lift and a per-ton-mile-cost reached, which will provide stern competition to any existing mode of travel. No aircraft has yet been designed to meet the demand of cargo but it will revolutionize transportation thinking when the ultimate is achieved. Before this can be done a national airport programme will be necessary.

The airport of tomorrow will be a magnet to attract, not alone aeronautic industry, but all forms of collateral industry to which the time factor in distribution has any significance. More presently located airports will be moved to accomodate industry than will be moved to accomodate passenger travel. Each municipality should make zoning a major consideration in any contemplated airport plans. The original investment in the airport itself will be amortized by the enhanced value of the adjacent lands if vision is used in the original transaction.

The airport should be thought of as an additional unit in industrial and commercial facilities and should be located with regard to surface travel units. It should cater to the established travel paths of commerce. Too often there is no established relationship and a great psychological advantage is overlooked.

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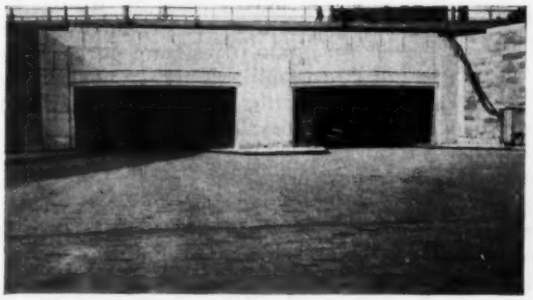

Entrance to Queens-Midtown Tunnel—New York City

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Because of the immature development of our national system great care should be exercised before laying out vast and expensive hangars and admistration set-ups. Wisdom calls for the laying down of airport surfaces, the careful zoning of areas, the construction of approach roads, the establishment of sound navigational facilities. What universal air transportation will ultimately need by way of hangars and service bases is not now known by anyone. First get the system and the details of utility will reveal themselves gradually.

Planning Our National Airport System

By MAJOR A. B. McMULLEN
Chief, Airport Division
Civil Aeronautics Administration

THE PAPER presented the situation in civil airports in the United States today and stressed the importance of long range planning by federal, state and local governments, in order that civil aviation may develop along with the military.

The $40,000,000 appropriation last year was the first Federal airport appropriation for the development of a national airport system, and is of prime importance in that it constitutes the first clear Federal statement of policy towards airport construction. In its role of coordinating agency, the C.A.A. hopes to plan and build the airport system needed now to adequately provide for the defense of this country, and at the same time be certain that system will be easily salvaged and converted to the use of civil aviation when existing conflicts have burned themselves out.

Believing that each community's stake in the situation is one or more well-located, well-planned and well-protected airports, constructive suggestions were offered to prevent the repetition of costly mistakes that have been made in the past.

Airport Zoning and Protection of Airport Approaches

By HOWARD KNOTTS
Counsel
American Association of Airport Executives

SAFETY in air transport with respect to the airport requires:

1. That a prompt and thorough re-examination be made of the history and philosophy of zoning both in this country and elsewhere. The objective is to bring to airport zoning all of its possible public aspects, namely, the recognition of esthetic purposes as well as all of the considerations of health, safety, morals, comfort, convenience, and the general welfare.

2. That we in and interested in aviation candidly recognize that airport protection from adjacent hazards has grown up piecemeal as emergency situations have demanded, and then mostly via the trial-and-error method. This is true as to the scientific as well as the legal developments. Our objectives should be basic uniformity and adequate flexibility in both fields. These can be accomplished best by seeing to it that the Airport Section of the Civil Aeronautics Administration has ample funds and personnel to complete speedily its excellent and already advanced studies as to both developments. A first further step is to get enacted in every state having a legislative session this year the Model Airport Zoning Act, dated Jan. 6, 1941, and released on Jan. 18, 1941, by Colonel Donald H. Connolly, Administrator of Civil Aernonautics. This model act represents, among others, the cooperative effort of the Airport Section of the Civil Aeronautics Administration, the National Conference of Commissioners on Uniform State Laws, the National Association of Real Estate Boards, the National Institute of Municipal Law Officers, the American Society of Planning Officials, the National Association of State Aviation Officials, the Air Transport Association of America, and the Civil Aeronautics Board. Following up on this enabling legislation municipal corporations and other authorized political subdivisions should promptly pass appropriate ordnances. It should also be noted that the model airport zoning act contemplates a qualified aviation agency as a part of each state government.

3. That the liaison established with the National Association of Real Estate Boards in connection with the drafting of the model airport zoning act be continued and enlarged, and that airport authorities cultivate such relationships with their respective adjacent property owners and operators. The objective is to invoke the zoning power so intelligently that a good neighbor airport policy can be established and fostered.

4. And that in aviation zoning the social benefits be put on a parity with the economic benefits, and that as much consideration be given the occupants of the zoned-adjacent territory as is now given the users of aviation facilities. This objective means better housing, both in homes and factories, for these neighbors of aviation, and it further means for these same people the creation or betterment of their recreational facilities. In fact this last objective embraces all those previously outlined.

Finally, it provides the one possible method to obtain completely open airport approaches and their subsequent protection. The remaining substantial obstacle to complete safety in flying is in connection with landings and take-offs. Pilots are superb, aircraft are excellent, and maintenance matches pilot and manufacturer performance. Traffic control is a thing of wonder and well abreast of the art of aeronautics. We now have yardsticks for aircraft area which provide an ample safety factor. Traffic congestion studies are far enough along to let us know why and when multiple airports will be necessary. Yet the cushion of safety for flying will only be most satisfactory when airport approaches are absolutely clear for all practical purposes. The power of zoning does not now extend this far. To supply the gap presently and to provide the educational means to enlarge the law in the future, we have an answer in the good neighbor airport policy.

CONTRACTING

Contracting and the WPA

By PERRY A. FELLOWS
Chief Engineer
Works Project Administration

IN OPERATING our program we have made every effort to cooperate with private industry, not to compete with it, the speaker claimed. Following are other abstracted remarks.

Despite all the elaborate precautions against competition with private industry, there are a few individuals who still complain of WPA competition. I need not tell you that the most vehement complaints have come from some construction contractors in the field of public works.

. . . We are still living in the United States, under a government whose prime purpose is to encourage private enterprise and to keep government economic activity at a minimum.

This is not only the general philosophy of the government, it is the philosophy of us in the WPA; for years we have looked for a way whereby the contract method

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could be fitted into WPA operations without destroying the fundamental purpose of providing work for the unemployed on the relief rolls. We experimented with a method of letting a sponsoring community turn over its share of operations to a contractor. As you know, the sponsoring community, which receives title to the completed work, usually is responsible for the bulk of materials and equipment needed on a project as well as for any skilled labor and supervision that are not available from the WPA. We tried out the idea of having the sponsor represented by a contractor, who contracted with the sponsoring community to provide all the materials and services required by the project and which were not to be secured from the WPA. The experiment worked out quite successfully, and last April all state Administrators were instructed to notify the local communities that they could avail themselves of this method in sponsoring WPA projects.

This new method of contracting on WPA operations has involved new problems for the contractors, who have not only had to make their bids to the local communities on the assumption that so much labor and materials would be supplied by the WPA, but have had to work with a labor force not their own. I am glad to say that the contractors have proved equal to the task. Our field force reports very few cases of friction and misunderstanding, and these have been of a minor order.

Pitfalls of Bidding

By WALTER C. SADLER
Professor Civil Engineering
University of Michigan

IN HIS paper Professor Sadler emphasized that contractors are often punctillious about minute details in known costs, and then ignore intangible or uncertain items which may be most serious under adverse conditions. The paper was heavily studded with practical illustrations from the legal field, demonstrating how the laws in the different states vary. Cases were analyzed from the fields of interpretation of contracts, workmen's compensation, patents, public risks, waters, mechanics liens, supervisory engineers, public officials, independent contractors, and arbitration.

The paper was concluded with the following observation: "In most cases a casual knowledge of the basic law is amply sufficient to guide the estimator, and this knowledge can be acquired easily by a small amount of thoughtful reading. In other cases advice of legal counsel is quite important and should be obtained before, rather than after, the difficulty has arisen."

Merit Rating System and Social Security Law

By C. J. FRANCE
Chairman
Rhode Island Unemployment Compensation Board

MR. FRANCE explained the operation of employers' merit rating or experience rating systems under the social security law. It was pointed out that 40 out of the 48 states now had provisions in their state unemployment compensation laws providing for employers' merit rating. Under this system, the employer with a low labor turnover, and, in consequence, with stabilized employment, is rewarded by having his tax rate for unemployment insurance reduced. On the other hand, the employer with a high labor turnover and an unfavorable employers' experience rating is subject to a penalty tax.

Mr. France pointed out that this system of variable rates would, in his opinion, result in penalty taxes on members of the construction industry as a whole, and particularly on contractors engaged in highway construction. Attention was called to the fact that the volume of highway construction was dependent very largely upon appropriations made by the federal, state and municipal governments. In consequence, the volume of unemployment in a given year was to a large extent beyond the control of the individual highway contractor.

Mr. France also pointed out that the road building industry was highly seasonal in character and that in many states it was impossible, because of climatic conditions, to build roads for four months in the year. This resulted in a large amount of unemployment in the winter months, and if the workers in the industry drew unemployment benefits during this slack period the accounts of highway contractors would be charged with this unemployment and might result in a penalty tax.

It was stated there was a growing opinion that this system of variable tax rates was a bad fiscal policy, because available statistics indicated that employers' experience rating would penalize the durable and semi-durable goods industry, the construction industry and the mining industry. These are the industries to which the Nation must look for recovery from depressions, and which are also largely responsible for an expanding economy and a higher standard of living.

Mr. France proposed, in lieu of experience rating, the following:

1. That the tax on employers be placed at 2 per cent of their total payrolls. This would be a reduction of 1 per cent. This proposed 2 per cent tax would be a uniform tax on all covered employers. This would necessitate the repeal of all employers' experience rating provisions.

2. That employees in covered employment should contribute 1 per cent of their total wages.

3. That the federal government, through general taxation, put into the fund a sum equivalent to 1 per cent of the total payrolls of employers.

Contractor Cooperation in ARBA Diversion Campaign

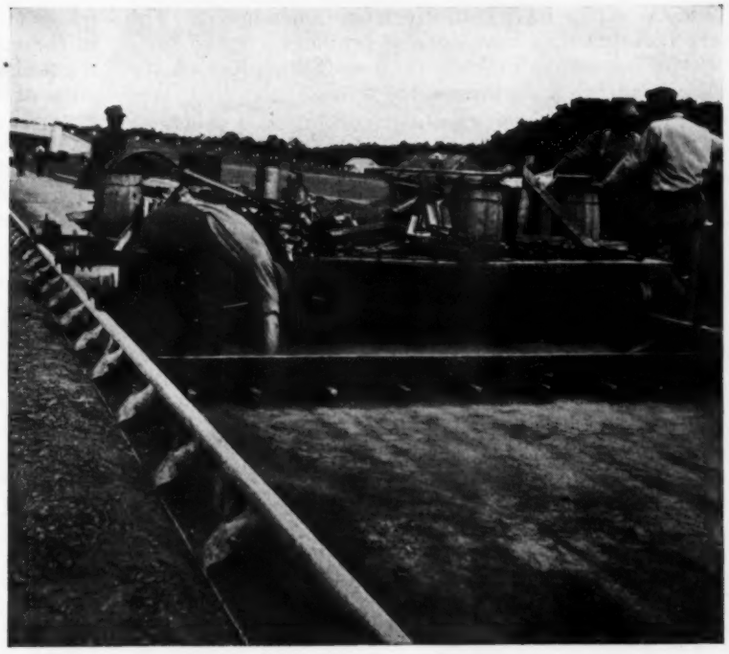
By E. E. DUFFY
Chairman
ARBA Diversion Committee

DESPITE the vast amount of energy spent in fighting specific diversion measures in various states, diversion has continued to grow. In 1940 it probably set a new high record. No figures are yet available for the last year but many states diverted more than in the previous year, 1939, when $181,654,000 of motor tax revenues was used for non-highway purposes.

Yet there was some good news in 1940. Four states, Idaho, Nevada, North Dakota and South Dakota, adopted constitutional amendments against diversion.

In 1940, of the amendments of all kinds submitted to the voters, two-thirds met defeat, but the four anti-diversion amendments carried by overwhelming majorities. The records show that every constitutional amendment, that stuck to the point and was not cluttered with other provisions, has been given an overwhelmingly majority of votes. Clearly, the problem is largely that of getting the state legislatures to sanction legislation which will place amendments on the public ballot. Unfortunately in most states amendments can not be instituted by the people; amendments must start with legislative action.

Construction steps lively



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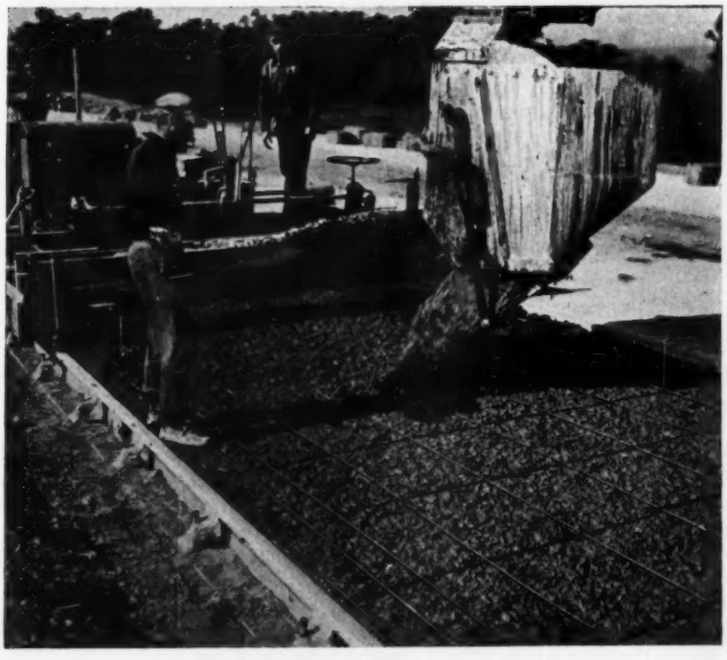

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Bethlehem Road Steel Service supplies you with all the road steel products you need for any construction job. Bar mats, reinforcing bars, road joints, highway cable guard, steel posts, steel sheet piling and steel H-piling and many other products made by Bethlehem combine the latest design improvements with outstanding economy.

You save three ways by placing all your requirements for road steel with Bethlehem. Road steel is delivered when you want it. A single order eliminates unnecessary bookkeeping, correspondence or telephoning. A combined shipment usually saves you on freight charges, particularly when you can get delivery from a Bethlehem warehouse near you in miles and minutes.

Bethlehem has established a special service to handle your road steel requirements quickly and efficiently—to make sure you get better value for the money you spend on road steel. Before you start your next contract, write, phone or wire Bethlehem Steel Company, Bethlehem, Pa., and ask for details on Bethlehem Road Steel Service.

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Eleven states have anti-diversion amendments. The mere fact that they have done so provides a sound basis for similar action in other states. The constitutional amendment has been thoroughly tested.

It's only by sticking together, working as a group on the one hand, and doing something, too, as an individual that diversion can be licked. This not only applies to the contractors, but to the manufacturers, the materials people, the automotive people, the petroleum people, and other directly interested groups. There have been cases where the failure of just one interested group to cooperate, was the cause of failure.

In most states contractors have strong groups, usually organized for the purpose of defending the industry against all comers and improving general contracting practice. Alone, you fellows would get nowhere in fighting diversion. But you can take steps to arouse the interest and support of others. And you can cooperate with others.

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Maintenance of City Pavement Under Contract System

By H. C. WHITEHURST
Director of Highways
District of Columbia

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PRIOR to July 1, 1928, the District of Columbia undertook to perform with day labor forces and through its own plant facilities all repairs of whatever nature necessary in connection with its highways.

In 1928 a committee was appointed to study the entire maintenance procedure with instructions to carefully consider the advisability of the contract system, in lieu of day-labor methods, in connection with repairs to high type pavements.

The Result of the Study.—The facts presented and the conclusions reached by the committee resulted in establishing for the District of Columbia Department of Highways the contract system for repairs to all high type pavements, sidewalks and alleys. This was more than 12 years ago. Your first question would naturally be, "After 12 years of experience are you satisfied that the recommendations were justified?" The answer is "Yes, more than justified." Your next question would probably deal with the economy and efficiency of the contract system as compared with the old system. To this we can state that it has been decidedly more economical and much more efficient. With an increase in roadway mileage from 641 miles in 1930 to 880 miles in 1940, and a corresponding increase in the sidewalk and alley areas, the total cost of maintenance of high type roadways, alleys and sidewalks in the District of Columbia has been reduced more than 10 per cent. The unit cost of repairs has never been higher than the records indicate they were in 1928. This in the face of increased cost of labor and materials. A fair portion of the economy resulting from the new procedure is directly attributive to more efficient methods of operating and in recent years the benefit resulting from a higher standard of maintenance and construction.

When a change to the contract system was under consideration we were warned by many that it could not be successfully conducted. Other cities had tried it and failed and many other discouraging statements were made. Among them we would be unable to have the contractor work where and when we wanted, that he would be interested in his construction work and not in our maintenance problems. All of these theories have been exploded. Contractors who have held these contracts now realize the value to them of this character of contract. They tend to interest the best type of contractor in the construction work of the department by making it possible to keep plants open the year around, and permits of more continual use of all equipment and organization.

Operation of Contract System.—The Department of Highways lets semi-annually four contracts of the maintenance type for:

1. Asphalt roadways.
2. Concrete roadways (including alleys and sidewalks).
3. Asphaltic concrete (supply only).
4. Surface treatment—macadam roadways.

The aggregate of these four contracts amounts to approximately $700,000 for the fiscal year.

The contracts cover not alone repairs to defective areas but replacement of street openings made by district and private utilities for underground construction. In fact, approximately 75 per cent of the quantities covered in Contracts 1 and 2 are utilized for cut repair. It should be stated that all work of repairs of whatever nature in public thoroughfares is performed by district agencies. We do not give any permit to others for such work, nor is the construction contractor required to repair any street openings for a period following the completion of his contract. Repairs are made with the same character of materials and under the same specifications as used for construction of the various types of pavements.

In the main, Washington has three types of primary roadway pavements; Sheet asphalt (on either concrete or black base), asphaltic concrete (on concrete or macadam base) and concrete (reinforced and non-reinforced). Sidewalks, in the main, are of concrete with a few of the old brick type. All improved alleys are concrete. The heater method of repairs is extensively used for repairing defective areas of all types of asphalt surfaces.

Permanent repairs to all street openings are made by district agents; never by the utility or others. The per square yard cost to the utility is a composite per square yard figure made up of the contract unit price for such work, plus inspection and overhead costs. There is no better way to emphasize the advantages to all concerned of the contract system than to quote a few of our charges as authorized by commissioners' order for replacement of street openings. The district endeavors to charge the actual cost for such work including the cost of administering the Cuts Section of the Street Division. The charges per square yard as authorized were:

	1928	1933	1936	1940
Sheet asphalt	$6.00	$5.00	$4.50	$4.00
Concrete	3.60	3.25	3.50	3.00
Macadam	3.50	3.25	3.50	3.25
Cement sidewalk	3.00	2.00	2.35	2.00

Method of Operation and Scope of Contracts.—1. Asphalt roadway repair contract:

This contract includes the repair of defective areas and street openings replacement with sheet asphalt and asphaltic concrete on concrete or black base using either the appropriate method of entire replacement or heating at any location in the city. This is the largest of the Maintenance contracts, running on a semi-annual basis to approximately $225,000. While the contract is mainly for the asphalt type of roadway and appurtenances thereto units are included so that work of other characters may be performed when contiguous thereto. Repairs to cuts in macadam roadways are also made under this contract

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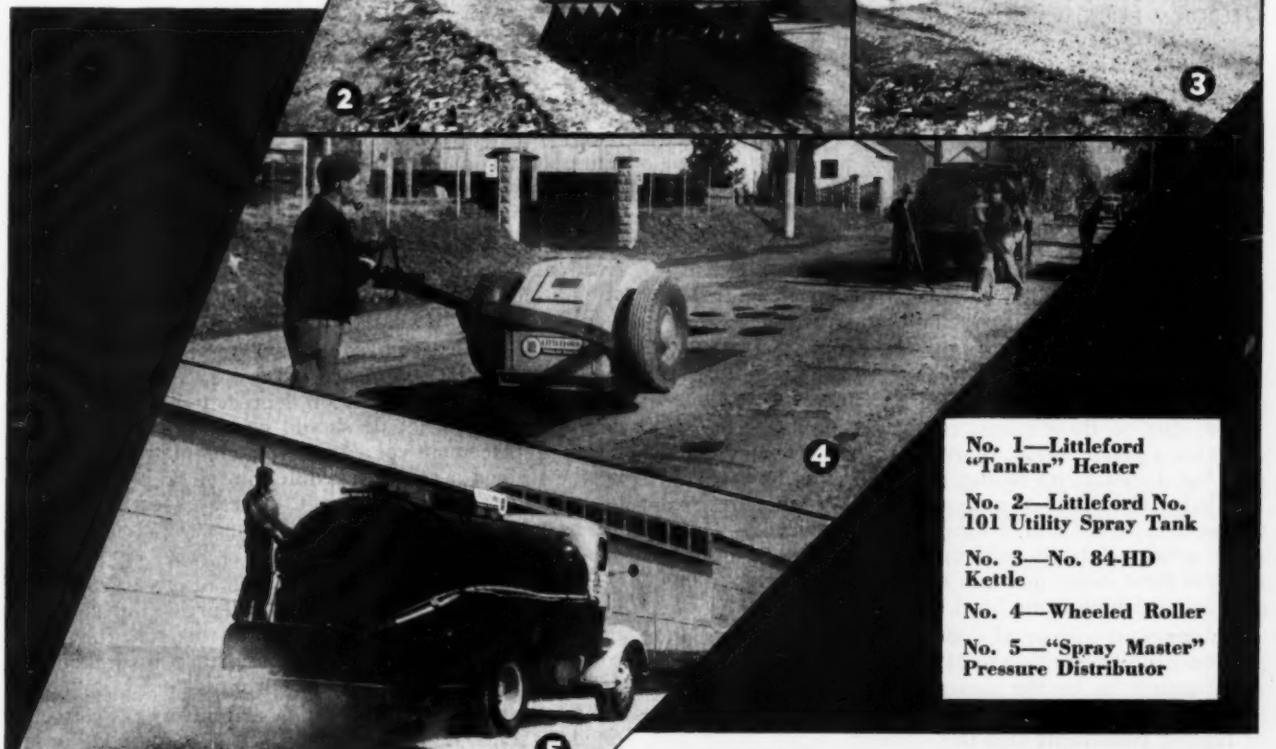

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with concrete base and asphaltic concrete surface. All concrete items are priced on the cubic yard basis and all asphaltic items on the ton basis. The work under each item includes furnishing and placing materials including removal, disposal of old material, and incidental work.

2. Concrete Roadway Repair Contract:

This contract includes the repair of defective areas and street openings replacement with reinforced concrete in all concrete roadways and with plain concrete in alleys and sidewalks. The semi-annual aggregate of this contract amounts to approximately $100,000. All concrete items are on the cubic yard basis and include the cost of furnishing, placing and incidental work.

3. Asphaltic Concrete Supply Contract:

This contract is for the furnishing of asphaltic concrete to the District of Columbia at contractor's plant in district trucks. The material is used for temporary work, pot hole patching, etc. It runs to approximately 25,000 tons annually.

4. Surface Treatment Contract:

This contract is for the surface treating of macadam roadways and includes furnishing of all materials and the application in the field. The district still has facilities for work of this character but lets to contract practically all such work under a complete service contract.

Depreciation and Rental Schedules

By ELDON M. FARNUM
Chairman
A. E. D. Rental Committee
Sales Manager
Geo. F. Smith Co.
St. Louis, Mo.

THERE are four main elements that go to make up the cost of rentals, or the contractor's cost of owning equipment. They are:

1. Depreciation.
2. Direct Labor Cost for Repair Work Done on Specific Machines.
3. Parts and Material Used on Specific Machines.
4. Equipment General Overhead.

General overhead corresponds with manufacturers' or distributors' factory burden, or a contractor's shop burden and consists of charges, although clearly equipment expense, that cannot be allocated to any particular machine. Included are such items as moving equipment in the warehouse, insurance, gasoline and oil, proper depreciation of shop machinery and tools for work on equipment, general warehouse expense, supervisor's wages, etc.

The sum of these items, compared with the total income for a given period, represents the percentage which your total cost bears to the rental receipts and are the TOTAL COSTS of owning or renting equipment. Each one is a separate and distinct charge in itself. Yet, in some articles I have read on depreciation, I find that some of these items, and in a few cases all of these items, are included under one head, Depreciation.

The greatest misuse of depreciation that a good many persons make, according to Mr. Farnum, is trying to add maintenance in to the depreciation column. In other words, effort is made to add the entire cost of owning or renting equipment into this column.

The object in figuring depreciation is, of course, to see that the original capital investment is returned during the economic life of the asset.

No matter what method of calculating depreciation is used, it still is only one item of the cost of operating or renting machinery.

Equipment distributors when establishing a rental rate must include depreciation in their evaluations. They find that when they buy new machines for rental service that they must hold and rent these machines for a period of six months to one year before they can afford to sell them. Why? Because when contractors, they claim, decide to buy a used machine, a top value or purchase price is set by the contractor, which they will pay for a used machine. This value is set up in relation to the price new. Equipment distributors claim they cannot afford to sell the machine for the price the contractor will pay for it, because the rentals received will not permit them to depreciate it to the figure the contractor feels justified in paying. Therefore, they must hold it until the rentals received will justify the selling price. This is one instance of cost, less salvage value.

The subject of Rental Schedules is one on which distributors and contractors will never be able to agree because the purposes for which they are compiled differ. Contractors rent equipment as a sideline to their business, according to Mr. Farnum, whereas distributors have only the rental of equipment from which to derive their profit.

An equipment distributor in arriving at a proper rental rate must base his rates on properly maintained equipment in strictly first class operating condition, the cost of proper maintenance and the cost of holding equipment in readiness for immediate service, and must properly reflect in this rate the fact that such equipment is rarely in service more than six months in a year. There have been attempts to base rental rates on a certain percentage of the new cost of specific machines. This has been found impractical because the average life of some classes of equipment is so variable. Uniform percentage of cost does not make allowance for this factor.

An equipment distributor who hopes to survive in the business of renting equipment must establish his rates on the basis of an accurate cost system of equipment rental.

Quite often contractors have endeavored to set up rental rates on equipment they desired to rent, based on rents shown in the A.G.C. Schedule. This, the speaker declared, is unfair, because he believes the A.G.C. Schedule is inconsistent.

A better understanding of this subject could be arrived at between the contractor and distributor if, in attempting to prepare rental schedules the two bodies would work a little closer together.

The speaker suggested that if the American Road Builders' Association desired to prepare a schedule that it should be based entirely on depreciation and the foundation of such schedule should be solely that of covering the replacement value of equipment and that it should not be termed a rental schedule, but should be referred to as Contractors' Equipment Ownership Cost and Liquidating Charges Schedule, rather than Depreciation and Rental Schedule.

This schedule could then be used by contractors for the purpose of determining their depreciation costs on the job and to the figure set out in this schedule, they could then add their items of maintenance, insurance and other overhead items including profit.

The Associated Equipment Distributors has just compiled a schedule which is known as Compilation of Rental Rates for Construction Equipment Gathered from All Sections of the United States. It represents average rental rates of distributors throughout the entire United States.

This, declared the speaker, is the first time a member of the Associated Equipment Distributors has appeared on the A.R.B.A. program, and should herald the cooperative working between the A.R.B.A. and the A.E.D.

NEW BOOKS

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By V. J. Brown
Publishing Director, ROADS AND STREETS
and
D. C. Runner
Assistant Materials Engineer,
U. S. Public Roads Administration

A word or phrase in one branch of engineering may have an entirely different meaning in some other branch. Various branches of applied engineering, all of which spring from the common root of natural and physical science, have found it expedient to develop a specialized vocabulary. This book is a step toward avoiding misunderstanding and difficulty from this cause for purposes of contracts, correspondence, agreements, price lists, specifications, etc., between the different branches of engineering, the public, and other professions. It is arranged in dictionary form. The book fills a need or want in engineering literature. It also initiates the standardization of engineering terms. Valuable appendices include English-Spanish terms; Spanish-English words; German-English aggregate terms; Symbols for Hydraulics; Standard Pump Classifications; Materials for Pumping Various Liquids; Abbreviations for Scientific and Engineering Terms; Symbols for Mechanics, Structural Engineering and Testing Materials; Weights and Measures; Conversion Factors.

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SOIL STABILIZATION

By V. J. Brown
Publishing Director, ROADS AND STREETS
C. A. Hogentogler
Senior Highway Engineer,
U. S. Public Roads Administration
C. A. Hogentogler, Jr.
Research Engineer,
George Washington University
Frank H. Newman, Jr.
Binder Research Engineer,
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Soils Engineer,
Missouri State Highway Department
E. S. Barber
Junior Highway Engineer,
U. S. Public Roads Administration

This book is reprinted from a series of articles published in ROADS AND STREETS. Demand for the series was world wide. The book treats of fundamentals of soils mechanics and soil stabilization such that the average engineer can get a complete understanding of this new branch of highway engineering.

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GEOLOGY FOR CIVIL ENGINEERS

As Related to Highway Engineering

By Delmar C. Runner
Assistant Materials Engineer,
U. S. Public Roads Administration

Rock and soils, and their characteristics, both physical and chemical, as well as their classifications and geographical distributions are discussed in such a way as to make this book particularly valuable for civil engineers and for engineering colleges. The chapters on material surveys, together with those on the petrographic microscope and its use constitute a real contribution to the fund of knowledge on engineering geology. This is the first time that the theories of general geology have been correlated by a competent engineer and geologist with the requirements of highway engineering. The book is written from the engineer's viewpoint for engineers. It puts into usable, understandable language the facts concerning rock formations and gravel deposits hardness or toughness values, how to recognize suitable or undesirable materials, and the source or origin of rock types. It is particularly useful to those engineers charged with the responsibility of materials selection for construction or maintenance work.

CONTENTS

Introduction; Value of Engineering Geology; Road Material Survey Methods; Relation of Geological Formations to Material Surveys; The Common Rock Making Minerals; Igneous Rocks; Metamorphic Rocks; Sedimentary Rocks; Origin and Roadbuilding Properties of Shale; Origin and Roadbuilding Properties of Caliche; Origin and Roadbuilding Properties of Limerock; Origin and Composition of Clays; Preparation and Properties of Blast Furnace Slag; Low Cost Road Surfaces; Petrography and the Quality of Rock; Sand and Gravel Deposits; Soils and Soil Tests; Glossary of Geological Terms; Glossary of Highway Terms; Names and Addresses of Highway Departments; States With Geological Commissions; Testing Material Procedures.

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ENGINEERING

A Method for Designing Non-Rigid Pavements

By A. T. GOLDBECK
Engineering Director
National Crushed Stone Association

THIS paper presents a rather simple method for arriving at the proper thickness of the non-rigid type of pavement surface to support a given wheel load carried on a given type of tire equipment. By means of tests made in the laboratory by the use of a bin 6 ft. square, the manner of distribution of subgrade pressures has been determined under different thicknesses from 4 to 10 in. of pavement surface. Loads were applied by means of a hydraulic jack to elliptical shaped bearing blocks simulating time imprint areas. It is assumed that a non-rigid pavement should be of such thickness that the maximum pressure obtained under the center of the wheel should at no time exceed the bearing value of the subgrade.

A method is suggested for determining bearing value, making use of a bearing block of 100 sq. in. in area. Formulas are then derived for thickness, first and merely for purposes of simplicity, making the arbitrary assumption that the subgrade pressures are confined within an area on the subgrade included within the lines sloping 45 degrees from the tire imprint area and are uniform within that area. The uniform pressure is then expressed in terms of the actual measured pressure, which in turn is assumed to be equal to the subgrade supporting value. Thus, formulas are derived for thickness in terms of wheel load, subgrade supporting value and the dimensions of the imprint area of the tire. These dimensions are known for given loads, tire equipment and inflation pressures.

As the result of the formulas thus derived, thickness may be determined after a pressure test is made to determine the supporting power of the subgrade. For general purposes of design, the pressure tests indicate that the maximum measured pressure under stable, non-rigid surfaces may be taken at from 2 to 2½ times the uniform pressure calculated as above indicated. On this basis, curves for the required thickness are shown in terms of wheel-load and subgrade support. Curves of required thickness for trucks on single and on dual tires and also for typical airplanes are shown.

Engineering Design of Superhighways

By CHAS. M. NOBLE
Special Highway Engineer
Pennsylvania Turnpike Commission

THERE appears to be a strong possibility that the highway construction industry is on the threshold of an era of express highway development and it is therefore important that the fundamentals of design be established on an authoritative basis in order that these new highways may not become obsolete after the lapse of a few years.

Engineering discussion over the past five years has rather definitely indicated the broad features which should be incorporated in modern express highway design as follows:

(1) The separation of the streams of traffic flowing in opposite direction.
(2) The elimination of all highway and railway grade crossings.
(3) The provision of wide smooth stable shoulders.
(4) The provision of two lanes of pavement in each direction.
(5) The provision of traffic lanes of sufficient width.
(6) The elimination of frontage and the control of the right of way.
(7) The exclusion of pedestrians.
(8) The selection of an adequate design speed.
(9) The provision of moderate grades.
(10) The provision of uniform and consistent operating conditions.
(11) The provision of specially designed access facilities.

The proper "order of magnitude" of each of these features was discussed in the address and related to the physical forces involved in automotive operation. A number of graphs to be used as tools in the design process were presented.

Tables were presented showing a breakdown of costs of the various features comprising an express highway project based on experience gained on the Pennsylvania Turnpike.

Airport Engineering and the Highway Engineer

By H. H. HOUK
Resident Engineer
Washington National Airport, Federal Interdepartmental Engineering Commission

THE COMMON objective of all means of conveyance is to overcome handicaps of distance to the transfer of men and commodities. For a given transfer the particular user selects that medium or combination of media which reduces the combined effect of hazard, time, cost and inconvenience on him to a minimum.

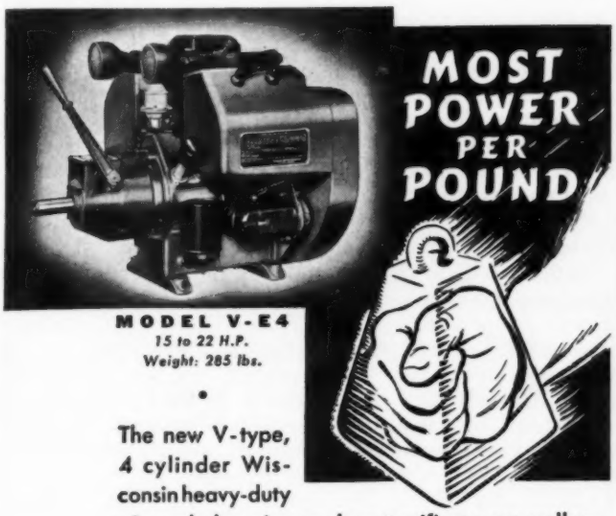
Air transport has become an integral part of our transportation systems and it must be coordinated with all the auxiliary means of surface transport in order to realize its speed advantage. This creates new problems in street and highway links to connecting streets, highways, railways and even waterways. Collaboration of the highway engineer, the city engineer and the city planner is necessary to insure adequate facilities for the expeditious movement of connecting motor transport. Some road construction is now necessary in the building of every airport. As civil aviation continues its unprecedented advance, metropolitan areas will need more airports, several major or primary airports and many supplementary or secondary airports, which will increase the demand for connecting surface transport facilities.

Full advantage has seldom been taken of the opportunities afforded to lessen the airport tax burden by obtaining direct revenue from proper services and activities that do not interfere with operation or add to transportation cost, yet which are desired by patrons and visitors. Designs that provide ample parking space and clear close-range view of aircraft and activities encourage the attendance of visitors and spectators. An airport may be coordinated with the park and recreational system and landscaped accordingly.

Having experienced the tremendous impact of the development of motor transport on metropolitan areas, airport engineers and highway engineers should act to avert another and similar charge of failure to measure up to their responsibility.

Airport engineers and highway engineers should collaborate in formulating long-time programs of carefully planned civil airport and connecting surface transport development to meet expanding needs and to permit the improvement and addition of facilities as the demand arises.

The collaboration of highway engineers experienced in grading, drainage, and surfacing will prove invaluable to engineers trained in aeronautics in the design and con-



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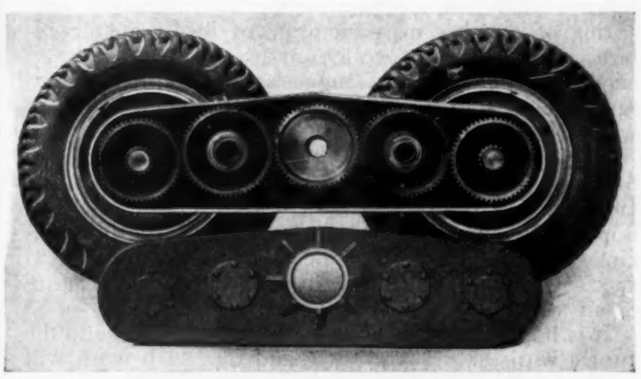

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struction of airports. The highway engineer appreciates the importance of sound, economical design of pavement structures and is fully cognizant of the loss and dissatisfaction that result from trial and error procedure. The highway engineer and the airport engineer should take care not to blindly follow precedent where conditions of service are basically different.

A continuous research program coupled with close study and thorough investigation of the service and behavior of airports in service will supply better information for the design and construction of airport details.

Pavement Joints and Their Functions

By J. W. KUSHING
Research Engineer
Michigan State Highway Department
Chairman
Committee on Pavement Joints

THE structural adequacy of a concrete pavement slab from the standpoint of strength and permanency is influenced by the features of design which determine its continuity and dimensions.

Today it is a recognized principle that slabs should be divided into definite widths and lengths, to provide relief from expansion, contraction and frictional forces.

The sectioning of concrete slabs and the provisional interruption of continuity by "joints," provides one of the most controversial subjects in the design of concrete pavements.

Early in 1940, the American Road Builders' Association recognized that this situation might be improved by the cooperative effort of highway engineer and manufacturer. To this end, a committee has been organized consisting of member manufacturers of load transfer devices, joint fillers and sealers and a group of highway engineers. The highway engineers personnel is representative of design, construction and maintenance, as well as geographical location.

The report submitted was an abstract of the workings of this committee to date together with an outline of future work. In connection with future work, several important general principles are discussed. These principles include, basic fundamentals of design, test and specification requirements, construction and maintenance details.

It is hoped that the report will serve as a guide to the future work of the committee and that such work will awaken interest in those who are partially informed or indifferent to this most important problem of concrete pavement construction.

Stabilization's Place in Our Present Day Highway Systems

By FRED BURGGRAF
Research Engineer
Highway Research Board

THIS paper included a discussion of, (1) soil graded aggregate with and without chemicals, (2) bituminous and, (3) portland cement stabilization. The total mileage of all these types constructed by state highway departments in 1939 was over 3,000 miles. This does not include the large mileage constructed by county, town and city highway organizations, and for airport runways.

The progress and trends of each type of stabilization was discussed. For soil-graded aggregate type the trend has been toward, (1) lower plasticity, (2) less fines, (3) greater thickness of mats, (4) higher density through moisture and compaction control during construction and (5) more appreciation of the need for proper "seasoning."

For bituminous stabilization the design and construction trends have been toward, (1) development of laboratory tests that reveal more closely the service behavior in the field, (2) leaner mixtures with greater depths, (3) drying the mixture to optimum moisture content prior to spreading and rolling, (4) rolling in thinner layers, (5) constructing roads to greater depth if sheepsfoot rollers are used and blading off top inch or so to assure a firm and hard surface, and (6) a greater appreciation of the necessity of proper "curing" of the base before placing a wearing course.

Portland cement stabilization was first investigated in 1935 by the Development Department of the Portland Cement Association. The result of these fundamental investigative efforts have produced practical scientific test procedures which were approved by the American Society for Testing Materials in 1940 as Tentative Standards. These tests include: (1) moisture and density relation of soil-cement mixtures; (2) wetting and drying tests, and (3) freezing and thawing tests.

Ths history of the development of structural design formulas for flexible pavements was also reviewed.

Further evidence given in the paper that stabilized roads have passed through the major experimental stage and are now established types of road construction are: (1) the setting up of a committee by the Department of Maintenance of the Highway Research Board to study the maintenance of roads built on stabilized bases of various kinds, (2) the construction of a test road by the California Highway Department in which eight different types of stabilized bases are being studied under actual controlled traffic conditions, and (3) the large personnel employed in soil-stabilization by state highway departments.

The paper concludes that although real progress has been made in the last few years, there is more to be learned before the full benfits of stabilization can be realized. Greater knowledge of the laws of nature especially as to the underlying principles that control the movement of moisture, the rate of freezing, and the rate of thawing, of wearing courses, stabilized bases, granular subbases and subgrades is necessary before more durable stabilized road structures become consistent realities. There are also strong indications that the results of pending research efforts in the field of structural design will permit the engineer to adapt designed stabilization into a road structure for any traffic or environmental condition.

Engineering and Construction Control of Embankments and Bases

By K. B. WOODS
Assistant Director
Joint Highway Research Project
Purdue University
Temporary Chairman
Soil Compaction Committee

THE recent trend toward moisture and density control of earth work for highway embankments and stabilization construction is one of the most important developments in highway engineering in the past ten years. Costs should not be increased appreciably by such control because of the ease with which density is obtained when placed with the proper equipment under the proper moisture content.

The importance of adequate compaction in both base courses and embankments can not be over-stressed. This fact may be readily appreciated, if in construction control, a density is always attained in which the volume of voids is small enough that when these voids are filled with water the resulting moisture content will not be detrimental. From experience it has been rather definitely

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ascertained that this maximum moisture content can be as high or slightly higher than the plastic limit for embankment materials. However, in stabilization this maximum attainable moisture content should be something below the plastic limit since the concentration of loads due to traffic is more apparent in such base courses than in embankment material buried several feet below the pavement.

The optimum moisture content as determined by the Proctor test has been found to be satisfactory for the density control of most embankment materials. However, in cases where densities higher than those given by the Proctor test are required, moisture content lower than the Proctor optimum should be employed. It has also been established that a moisture content lower than the optimum is essential for density control of stabilized materials.

Equipment developments for embankment construction appear to be keeping pace satisfactorily with requirements. However, in the field of stabilization and base course construction, adequate density is difficult to obtain which suggests the possibility of improvement in the usually employed equipment.

Compaction of Embankment and Foundation Materials

By FRANK NIKIRK
Civil Engineer
Caterpillar Tractor Co.
Chairman
Manufacturers' Sub-Committee of the Soil Compaction Committee

IN THIS report, attention is called to the fact that the object of compaction is to obtain a sufficient and a uniform amount of solid material, as measured by its dry weight, in each cubic foot of an embankment and the chief function of moisture is to act as a lubricant during the compacting process. There are, however, many other factors that influence the degree of desity that may be obtained. It would, therefore, seem advisable to consider the relative economy of obtaining the required density with various methods, types of equipment and percentages of moisture rather than to restrict, within narrow limits, the amount of moisture within the soil for all methods of compacting.

In arid regions a strict adherance to the optimum moisture content, as at present determined, would result in excessive cost for water. In other localities, subject to heavy rains during the working season, moisture control between narrow limits will cause delays that are costly to the contractor and must be provided for in the price bid.

The report states that there are three mechanical means of compacting soils; namely by the application of weight, impact and vibration. It shows the soil types where each is most effective and explains the action obtained by various types of hauling, spreading and compacting units. Reference is made to studies in the distribution of stress throughout a soil due to static loads and attention is called to the need for further invetsigations of the effect of moving loads. These should include both the qualitative and quantitative analysis of reactions under loads carried on large low-pressure pneumatic tires or by track-type equipment.

The report calls for the continued cooperation between the engineer, the contractor and the equipment manufacturer. In this way it is hoped that present equipment may be used more advantageously, improvements may be made in present machines or new machines may be developed to the end that greater economy may result in the compaction of earth embankments and foundations.

Present Practices in Use of Moisture in the Construction of Embankments and Stabilized Bases

By THOS. E. STANTON
Engineer of Materials and Tests
California Division of Highways
Chairman
Engineers' Sub-Committee of the Soil Compaction Committee

THE initial work of the engineer's sub-committee of the Soil Compaction Committee has been confined to a preliminary study of:

(1) Present practices of the state highway departments as to the use of moisture control in compaction of embankments and subgrades.

(2) Results obtained from the various types and weights of rolling equipment used in compaction work.

This report consists mainly of a summary of the replies to a questionnaire sent to state highway departments; no attempt being made to evaluate the results of the different methods used by the different states nor to reach any conclusions as to the best methods of constructing controlled embankments and fills.

Present Practice of the State Highway Departments as to the Use of Moisture Control in Compaction of Embankments and Subgrades.—Thirty states now exercise some measure of moisture control in embankment and substantially the same number in subgrade construction.

While many of the remaining states do not specifically provide for official control procedure there is a certain measure of control during construction depending on the experience and judgment of the engineer.

This extensive practice of moisture control to secure optimum density is a comparatively recent development. Following an extensive investigation of the "Proctor" method of determining optimum moisture by the United State Public Roads Administration and the A.S.T.M., the method has become a standard of the A.A.S.H.O. and the A.S.T.M. and is in use by approximately 24 states.

Specifications.—Specifications for embankment construction vary widely, but the requirements under different jurisdictions can be classified in three groups:

1. Requirements which fix the method of construction such as control of moisture, unit weight and type and number of trips of the roller and which provide pay items for several construction operations.

2. Requirements which specify results in a finished embankment in terms of a minimum relative compaction or density, thus permitting the contractor to use any equipment or methods which will produce satisfactory results.

3. Requirements which not only specify results in the completed embankment, but also fix the maximum thickness of the layers and minimum number of rollers and provide a pay item for the water.

When contractors become thoroughly familiar with the fundamentals of soil compaction, it may be practicable to modify the specifications to specify the final results, leaving the detailed method of construction up to the contractor so that he can determine the most efficient method of compacting the material and what moisture content and weight and type of hauling equipment and rollers are necessary to satisfactorily consolidate various types of soil. Nevertheless, to safeguard dams and some other important embankment construction, it may always be necessary to fix a minimum and maximum moisture content for the completed structure.

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ECONOMICS OF HIGHWAY BRIDGE TYPES

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Assistant State Highway Engineer,
Oregon State Highway Commission

A most urgent need in the field of highway and structural engineering has been met by this clear, concise treatise. The fundamentals of economic analysis and the principles governing the selection of bridge types are profusely illustrated with necessary cost and quantity curves. The text deals more particularly with the ordinary highway bridge structures rather than the occasional, spectacular or exceptional bridge crossing.

The text has been compiled with a view to its utility not only to the practicing engineer, but to the undergraduate student in highway and civil engineering as well. It is the author's thought that such a volume should be assigned to the student prior to or, at least, simultaneously with his embarkation upon the study of structural design proper.

The tables of quantities and costs should prove of great benefit to the engineer in the field who is engaged in highway location or relocation, to highway maintenance engineering organizations, and to field parties, divisional organizations, municipal and county engineers, and others engaged in the construction, location, or design of highway bridges.

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EDITORIAL

THAT EQUIPMENT RENTAL PROBLEM

ANOTHER convention of the American Road Builders' Association is passed. It was a most successful affair from every point of view—pertinent subjects, big names, financial gain, attendance, spirit, and general activity. All meeting rooms were crowded at all times. The writer sat in one of the contractors' sessions where discussion had to be halted in order to continue the program. The cause was Mr. Eldon Farnum's paper on "Equipment Depreciation and Rental Schedules."

This was the first time, in the writer's recollection, that an equipment distributor appeared on the program of the American Road Builders' Association. According to the author of the paper, rental schedules for construction equipment should be different as between the equipment distributor and the contractor. He claimed that they should be prepared for different purposes.

Rental practice employed by distributors was questioned by a contractor. This led to considerable discussion which had to be continued after the rest of the program was concluded.

Before a depreciation schedule or a rental schedule is thrust upon the highway contractor and the equipment distributor let them get together and set up tables of their own and submit them to governmental agencies.

PROFIT

PRIOR to a recent meeting it was desired to promote the meeting with some direct mail publicity. In the mailing piece the word "profit" appeared. It evoked some discussion which clearly indicated an attitude or a type of thinking with respect to the word.

The personalities have no bearing on the case, whatsoever, because the attitude seems to be ingrained in more than a few people. This writer would like to make a few remarks about the attitude. It appeared from discussion about the use of the word that it was something to be taken for granted but not to be mentioned. Maybe that's true, the writer, however, has difficulty understanding why this should be so.

This country has been developed to the highest standard of living for the population as a whole than any other country in the world. Our development has indisputably been accredited to the operation of a capitalistic system of enterprise in our national economy. With this statement I think most of the people in this country agrees. The energizing force of the capitalistic system is profit. Without profit capitalism would crumble. Other items are also factors in a capitalistic system but they exert a minor influence compared to the impelling force of desire to make capital earn a profit.

That being the case, what is there that is so unholy about earning a profit as to require us to speak of it in whispers or even not at all,—merely understand that it is involved without speaking about it.

Why are we building a huge army? "To defend this country," you say. What do you intend to defend? "Your property and the lives of your people," you say, but in that statement you fail to recognize the basic reason for arming for defense. What we are preparing to defend are our social and economic institutions. We wish to remain a free republican people earning our bread and building our country in conformity with the principles of a capitalistic economy. Since "profit" in its narrowest, financial sense, is a fundamental factor in this type of economy, why should we mention the word only in whispers or be afraid to even mention it at all. To the writer this attitude smacks of double talk. Maybe he's wrong.

It has been argued that a politician going before the people asking to be elected to a certain office would be disastrously defeated if he supported a policy that would advocate a "profit" for any certain group. It has been said that any group appearing before a legislative committee (who are politicians) requesting funds for a certain project, let us say roads, would leave the conference room with a rejection if they mentioned that anybody would make a profit out of the expenditure of the funds. It seems to the writer that conditions have come to a queer state of affairs when it becomes an unpardonable error to mention the word "profit" before state or federal legislators in a country where the capitalistic system is the recognized form of economy.

The writer also has heard it said, "There are some things you can't talk about, and profit is one of them." Spurious argument of this type reveals lack of intestinal fortitude to face facts and promotes the weak policy of coloring or shading a subject so it will be easier to explain. If any profit is to be made out of contract, force account, day labor, or even WPA road work the writer sees no reason for running into a dark room, closing all doors and windows, and whispering to one another in order to talk about it.

HIGHWAY RESERVE

DAILY press statements indicate that the President is considering post-war public works activities. Statements indicate that highways as a group are included in those activities he desires to shelve for the present.

This could be an alarming statement if one were to accept it in whole without some analysis. There is no doubt but that regular federal aid will continue. It will undoubtedly continue, at least in the reduced form in which it is now aiding state work. Hence, so far as shelving regular federal aid highway work is concerned, we believe that was not meant when the statement was issued.

The report which the Public Roads Administration will make to the President regarding defense road work will, undoubtedly, recommend that federal funds be authorized for access roads and streets. Expenditure recommendations will probably be almost entirely confined to access roads. At that, the recommended expenditures can hardly be less than the regular federal aid annual allotments. So we have these two federal items to which to look forward this year.

The kind of projects which the President probably meant by his statement were large inter-regional superhighway projects and extensive secondary road or municipal extension projects. There is no cause for alarm in the statements, as the writer analyzes the setup, but rather a warning to states, counties, and cities to get their projects planned and the engineering accomplished so they may be ready to accept federal aid in increased amounts when it becomes available.

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CHAPTER 12. UNTREATED BASES AND SURFACES—Waterbound macadam, crushed rock and gravel construction.
CHAPTER 13. STABILIZATION OF BASES AND SURFACES—This chapter is devoted chiefly to work with calcium chloride, articles on portland cement and bituminous stabilization being given in the chapters on concrete and bituminous construction.
CHAPTER 14. BITUMINOUS SURFACES AND BASES—The five parts of this long chapter contain articles on various methods in different states. Part 1, Surface Treatments; Part 2, Bituminous Macadam; Part 3, Mixed-in-Place Construction; Part 4, Traveling Plant Construction; Part 5, Stationary Plant Construction.
CHAPTER 15. CONCRETE SURFACES AND BASES—Contains numerous detailed records of construction. There are articles on work with 27-E pavers, 34-E pavers, tandem set-ups, batching, hauling, curing, joints, cement-bound macadam, soil-cement roads, stabilization, and other subjects.
CHAPTER 16. BRICK PAVEMENTS—Records of brick pavement construction from various cities and states, including an article on vibrated monolithic. Short references to granite block.
CHAPTER 17. SIDEWALKS, CURBS AND GUTTERS—Miscellaneous prices and details of construction.
CHAPTER 18. WALLS, FENCES AND GUARD RAILS—A brief chapter of data on these items of highway construction.
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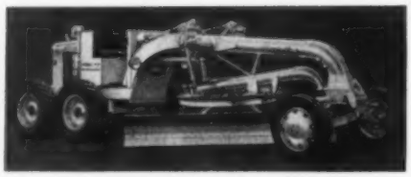

New Model "AD" Grader

axle or circle. The exclusive "Hi-arch" front axle has 22 in. of clearance and there is 6¾ in. of clearance between the "Roll-away" blade and the circle. Power is supplied by the General Motors 2-cycle Diesel engine developing 75 brake horsepower. This 2-cycle engine has a power stroke on every down stroke of the piston, therefore, delivers as much power as a 4-cycle engine twice its size. It offers the advantages of unit injection, four-way cooling, faster acceleration, smoother power, easy starting and fully protected by air, oil and fuel filters.. The transmission features short, heavy shafts and carburized and hardened gears for long, trouble-free service. It has a range of six forward and three reverse speeds, and with throttle control forward speeds from 1.48 to 16.6 m.p.h. and reverse speeds from 1.75 to 6.15 m.p.h. can be selected at will. Two speed mechanical controls are employed with a low speed set for close adjustments and a high speed set for fast movement. The grader has a 10-in. tubular frame plus heavy box section girders. The lift cases are mounted directly over the circle for rigid blade control. The full revolving blade has a bank cutting angle of 90 degrees and has a blade reach outside the front wheels of 5 ft. 7½ in. The tandem drive assembly is supported on a 4½ in. main drive shaft and is chain driven. Standard equipment includes electric starting and lighting, leaning wheel front axle, adjustable radiator shutters. muffler, 12-ft. moldboard, two 7.50-24 (10 ply) front tires and four 12.75-24 (8 ply) rear tires. For special conditions 10 and 14-ft. moldboards, 2-ft. extensions, 11 tooth scarifiers, all steel canopy top or all steel cab and a V-type snow plow are available.

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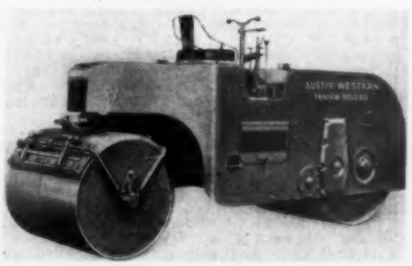

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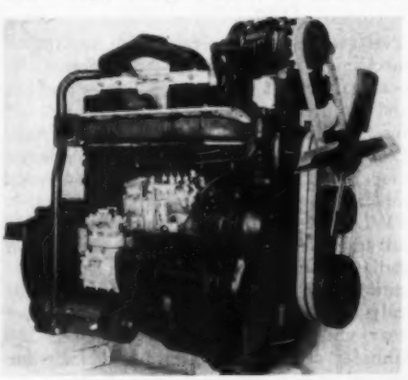

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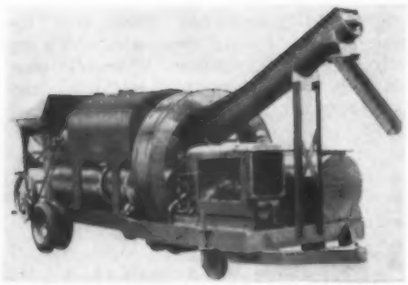
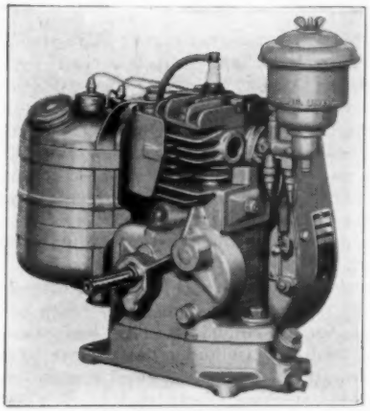


New Portable "Twin Dryer" Portable Asphalt Plant

the frame, out of the way, when not in use. The plant is supplied materials by conveyor or fed directly from a bin. It has a twin hopper from which material is metered by mechanical feeder to twin dryers—sand to one dryer and aggregates to the other. These rotary dryers are heated by oil fired burners. The heat that escapes from dryers is utilized to heat the asphalt in the 700 gal. tank above the dryers. From the dryers the material is elevated by the space-saving rotavator to the screw pug mill. The tumbling and discharge action aerates the material releasing steam resulting in a dryer material. Hot oil is added in the pug mill and the agitator screws thoroughly cut, mix and blend the material at the same time conveying it to a swivel chute for convenient truck loading. The "Twin Dryer" plant is ruggedly constructed yet so compact that it is only 9 ft. 6 in. wide, less than 30 ft. long overall, 11 ft. 2 in. high and weighs only 11 tons. Rear wheels are dual pneumatic-tired. A new bulletin, No. 57, giving further details, is available from the Universal Crusher Co., Cedar Rapids, Ia.

New Gasoline Motors

Two new additions to their line of small gasoline motors has been announced by the Briggs & Stratton Corp., Milwaukee, Wis. Model "U" is a compact unit rated at 1 H.P., with a speed range of 2200 to 3200 r.p.m., although actual dynamometer tests show it to develop 1.25 H.P. at 2700 r.p.m. It has a 2 in. x 2 in. bore and stroke with a piston displacement of 6.28 cu. in. The 5-pint fuel tank is mounted vertically beside the cylinder block rather than on top, which reduces the overall height of the complete unit. A specially designed suction type of carburetor is used to draw the fuel from the tank. In addition to the standard model shown above, it is also available with gear reductions of 6-to-1 and 2-to-1. Model "N" motor has the same piston displacement as the "U", but develops up to 2 H.P. at 4000 r.p.m. under test, although it is rated by the manufacturer at 1.5 H.P., with speed range of 2600 to 4000 r.p.m. A float-feed type of carburetor is used which is fed by gravity system from the 2-quart fuel tank mounted above the cylinder block. It is a higher speed motor than the "U" and was designed to meet the demands for a more powerful small motor for certain operating requirements. The Model "N" series motor is available in special types incorporating the following features: Gear reductions of 6-to-1 and 2-to-1; direct mounting crankcase, machined and tapped with ball bearings on the drive side. Both models are air-cooled, 4-cycle, L-head design. A patented high tension magneto is built into the flywheel which is both moisture and dust-proof. A pump supplies lubrication to all moving parts. The connecting rods and pistons are made of durable aluminum alloy which reduce weight and increase the unit's operating efficiency. An adjustable, pneumatic type of governor regulates the motor speed. Detailed specification sheets are available upon request to the manufacturer.



Model "U" Motor

New FWD Trucks

Attractive new general design and major mechanical improvements that increase the performance of the truck; lighter weight and greater accessibility are features of the 1941 line of the Four Wheel Drive Auto Co., Clintonville, Wis. The newly designed models of the lighter "H" series are already available and refinements in some 15 other FWD models will soon be announced. The attractive new styling features horizontal radiator louvers with a radiator shell separate from the core, a frame that is tapered only on the under side on the front and rear and refinements in the engine and transfer case. Cab appointments, including an adjustable seat and refinements in the location of instruments, provide greater driver comfort and greater visibility. The newly designed skirting in the front of the fenders serves a dual purpose, protecting the radiator grill and fenders, and also acting as a bumper. Of special interest is the provision made for use of optional engines which in the "H" series allows for engines from 85 h.p. to 113 h.p. Two series of axles are also available in these trucks, to take gross loads up to 20,000 lb. The

New FWD Truck

Cheaper than wood in the long run

FASTER..BETTER

Blaw-Knox STEEL STREET FORMS will do your street paving work quicker and cheaper. The smooth steel imparts a smooth finish to the concrete, eliminating hand finishing.

Blaw-Knox Forms are built for long service; quick installation and dismantling; and are rigidly braced to hold their position when being filled with concrete.

Blaw-Knox Catalog No. 1527 shows how any design or cross section of work can be accommodated with Blaw-Knox Steel Street Forms. We'll gladly send you a copy.

Always ready for action to build . . .

- Combined Curb and Gutter
- Straight or Battered Curbs
- Integral Curb
- Any shape of Curb Face
- Sidewalks, etc.

Blaw-Knox
BLAW-KNOX DIVISION of Blaw-Knox Co.
FARMERS BANK BUILDING . PITTSBURGH, PA.
STEEL STREET FORMS
BLAW-KNOX BINS AND BATCHERS . ROAD FORMS . STREET FORMS . CONCRETE SPREADERS . TAMPING ROLLERS . VIBRATORS
CONCRETE BUCKETS . CLAMSHELL BUCKETS . TRUCK MIXERS . STRIPING MACHINES . TURNTABLES . ROAD FINISHERS . STEEL FORMS

transfer case is arranged so that a power take off can be installed that will utilize all the speeds of the transmission and the full torque of the motor for earth boring machines and similar services. The fender arrangement of the new FWDs accommodates all types of snow plows and front end equipment without alterations to the skirting and fenders. Another feature allows for either a high or low mounting of the engine transmission and transfer case, depending upon the height of the body mount. Where center scraper plow and under body graders are used a 23 in. clearance under the center of the truck is provided. Besides the major changes mentioned above, the 1941 models will embody many improvements that have been developed in FWD's plant in Clintonville during the past few years. Included in these developments are a new FWD manufactured axle for the "H" series and a power proportioning differential for 4 and 6-wheel drive trucks which divides the power in the center of the truck to each axle in proportion to its normal loaded weight. Of special interest to heavy duty truck operators is the new 10-speed transmission, also of FWD manufacture. All models are furnished in both conventional and cab-over-engine design. provision being made for from two to seven passengers in the driver's compartment.

Elastic Stop Nut of Knurled-Shank Clinch Type

For fastening sheet-metal assemblies in which the parts must be readily removed and returned to position, a clinch type of self-locking nut with knurled shank is offered by Elastic Stop Nut Corporation, 2322 C Vauxhall Road, Union, N. J.

To install the nut, a hole is drilled in the structure and the shank is pressed into the hole. The mouth of the shank is then spread against the back of the structure to effect a clinching hold. The knurling engages the drilled surface and thus assists in eliminating any turning of the nut.

The head of the nut is fitted with the vulcanized fiber collar which characterizes all types of Elastic Stop nuts. This collar, being unthreaded, resists the entrance of the screw, thus automatically taking up all thread play and bringing the load-carrying thread faces of nut and screw into a tight pressure-contact. As the screw thread impresses its way through the collar, this pressure is maintained and increased to such a degree that the screw can not work loose, even under the most severe vibration. Because of the resilient character of the fiber collar, the screw may be removed and replaced repeatedly without loss of the locking action.

These nuts are available in a complete range of sizes, thread systems, shank lengths, and materials.

New Trailer Mounted Pavement Tester Drill

A new pavement tester drill is mounted on a 2-wheel trailer which can be towed at speeds up to 35 miles per hour. The trailer mounting allows rapid transit and ready availability, yet frees the towing truck for other work. This new drill operates a 7½ in. diameter shot bit for obtaining test cores from concrete pavement. A

Pavement Core Drill Mounted on Trailer

4-cylinder Hercules gasoline engine model ZXB, 2⅝ in. bore, 3 in. stroke, furnishes the necessary power. A large tool compartment and a built-in 25-gal. water tank are added features. For further information write ROADS AND STREETS, referring to RS131

New Sand Spreader

A new dual drive de-icer that can be used with or without the engine has been brought out by a Wisconsin company. The illustration shows the unit attached to a truck. The unit can be operated by standing down on the platform where the operator is close to the ground; standing in the truck box; backward, which is ideal for backing trucks up slippery hills; or forwards at any truck speed. Spread is dependent on range of truck travel when the de-icer

Parmanco
HORIZONTAL DRILLS

Stop . . . AND THINK!

Parmanco Drills have convinced owners of their true value—

In the Coal field, the Iron range, the Utility and the Contracting field.

We build a model for every need.
Parmanco Drills are now in their fourth year of successful operations.

WRITE US YOUR DRILLING PROBLEMS

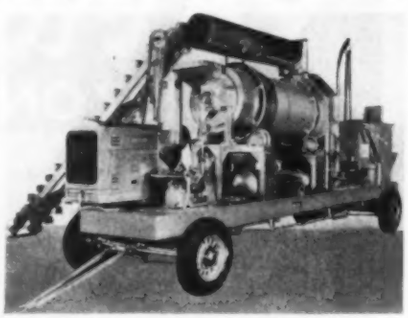
PARIS MANUFACTURING CO., INC.
PARIS, ILLINOIS

De-Icer Attached to Truck

is used with motor. This new dual unit has safety lights, sand suppressor that permits the operator to protect oncoming traffic, mercury automatic clutch that automatically "breaks" the power flow when the unit is stopped by rocks, etc., or when engine is turned off, and dual drive that requires less than five minutes to change from one to another. Other features are standard tire width, adjustable deflectors, self feeding hopper, inverted cone type agitator, and all standard parts throughout. It is made of boiler steel plate throughout, electro-welded at all vital points, and weighs 550 lb. It operates from an air-cooled engine, foot starter, throttle control mounted at top of safety rail, and engine engages at 800 r.p.m., a precaution against gear breakage. Further information can be obtained from ROADS AND STREETS by referring to.....RS132

New Portable Asphalt Repair Plant

For street and highway repair work, a one-unit complete portable asphalt plant with capacity of 8 to 10 tons per hour, has been brought out by the White Manufacturing Co., Elkhart, Ind., as an addition to its line of smaller repair trucks and larger maintenance plants. The new model is designated as L-8 and contains numerous features of the larger White machines. Conspicuous among them is the internally fired rotating dryer and air operation of discharge mechanism. Drying drum is 36 in. in diameter by 8 ft. long, mounted on roller bearing trunnions and chain driven. It has internal longitudinal side shelves for cascading the aggregate and also an internal centrally hung cross-flight which considerably increases the area of hot steel plate on which the material dries. It is fired by low pressure oil burner, with fuel fed by engine driven pump and air supplied by Worthington 2-cylinder air cooled compressor. The batch type pug mixer has single axle mounted in roller bearings, with individual blades set on 90° quadrant, a style of mixer used for many years on other White plants with excellent results. Its capacity is 750 lb. per batch. Asphalt is heated in 220-gal. kettle, with two oil burners, fire-proof top and thermometer. Power is furnished by one Continental 6-cylinder 32-h.p. engine which drives the dryer drum, pug mixer, air compressor, fuel pump and cold loading elevator. Simplicity of operation is stressed in this unit. One man standing in front of mixer has three small levers to control the air operated cylinders attached to dryer, mixer and measuring hopper discharge gates. A valve admits hot bitumen to a graduated measuring trough which is manually dumped over the full length of the mixer. Another man is required to supervise operation of the machinery and to see that aggregate is continually feeding into the elevator boot. Other features which are emphasized are the mounting of the complete unit on one chassis, with semi-elliptic springs and pneumatic tires. When machine is to be moved, the elevator is swung on a pivot into position parallel to the frame where it is held during transit. The only extra apparatus is a fuel drum. This machine makes any type of bituminous mix, either for immediate hot application or for deferred laying. Its weight is 15,000 lb.



New White Portable Asphalt Plant

New Printing Machines

New simplicity of design and new operating usefulness are claimed for a new printer just announced. Known as the Model "55" BW Printer, this machine is said to be the most compact printer of its capacity on the market, since it measures only 32 in. wide, 62 in. long, and 48 in. high. The Model "55," a 42-in. printer, operates with either cut sheets or roll stock. It is stated to print ink tracings at from 12 to 15 ft. per minute. A full-view speed indicator placed at the center of the front, above the feed board, makes the speed of the machine readily visible to the operator at all times. An exclusive feature of the Model "55" Printer is its new print and tracing return. The entire top of the machine serves as a return tray, and the return is so designed that the tracing enters the tray on top of the print—in exactly the same way as it is inserted in the machine. No reversing of the tracing is necessary same way as it is inserted in the machine. Furthermore, as they emerge from the printer onto the tray, exposed sheets stack themselves almost automatically. For further information write ROADS AND STREETS, and refer to RS125

Model "55" BW Printer

YOUR PAVING TEAM FOR '41
BLAW-KNOX
CONCRETE SPREADERS
VIBRATORS
ROAD FINISHERS
• Mechanized Production Units—the new Blaw-Knox CONCRETE SPREADER and the new Blaw-Knox model "X" FINISHING MACHINE, working together or separately, are today's most widely discussed developments in the paving industry. Either machine can be equipped with vibration.
• Sure—we'll be glad to tell you about this famous paving team for wide and narrow pavements.
BLAW-KNOX DIVISION
of Blaw-Knox Company
Farmer's Bank Building Pittsburgh, Pa.
40
BLAW-KNOX BINS AND BATCHERS • ROAD FORMS • STREET FORMS • CONCRETE SPREADERS • TAMPING ROLLERS • VIBRATORS
CONCRETE BUCKETS • CLAMSHELL BUCKETS • TRUCK MIXERS • STRIPING MACHINES • TURNTABLES • ROAD FINISHERS • STEEL FORMS

WITH THE MANUFACTURERS

Honor J. W. Gardner on Completion of 60 Years of Service

As a symbol of his 60 years of service with the Gardner-Denver Co., Quincy, Ill., J. W. Gardner, Chairman of the Executive Committee of the Board of Directors of the Gardner-Denver Co. wears on his watch chain a tiny gold, diamond-set model of a steam governor. The token was recently presented to Mr. Gardner by his associates, and recalls the fact that the present Gardner-Denver Co. grew from the original Gardner Governor Co., world-famous for its steam governors, and founded in 1854 by Mr. Gardner's father, the late Robert W. Gardner. Mr. J. W. Gardner first joined his company as a boy of 17, starting as an apprentice machinist. His service includes nearly 30 years as president and, in more recent years, as chairman of the executive committee of the board of directors. Today, with Gardner-Denver air compressors, pumps, rock drills and mine car loaders known throughout industry, the 60th anniversary of Mr. Gardner's service follows by little more than a week the recently announced expansion of the company through the purchase of a 13-acre plant near the main plant of the Gardner-Denver Company in Quincy.

J. W. Gardner

Harry J. Schultz Joins Worthington Pump and Machinery Corporation

Harry J. Schultz has been appointed Central regional manager of the construction equipment division of Worthington Pump and Machinery Corporation. He will make his headquarters at Worthington's Chicago office in the Daily News Bldg., 400 West Madison St. Mr. Schultz was formerly manager of the Contractors Division of the Independent Pneumatic Tool Company. He enjoys wide friendship with construction equipment distributors throughout the country.

General Announces New Distributors

The General Excavator Co., Marion, O., manufacturer of excavators and material handling equipment, has appointed the following distributors: J. S. Main, Seekonk, Mass., for the state of Rhode Island. Karcher-Wolter-Foley Co., 300 Wichita St., Wichita, Kan., for the southeastern counties of Kansas. Southern Equipment & Tractor Co., Monroe, La., for the northern parishes of Louisiana.

Buckeye Appoints New Distributor

The Buckeye Traction Ditcher Co. of Findlay, O., has appointed the Brandeis Machinery & Supply Co., Brook and Warnock Sts., Louisville, Ky., as distributors of Buckeye road wideners, spreaders, trenchers and R-B finegraders.

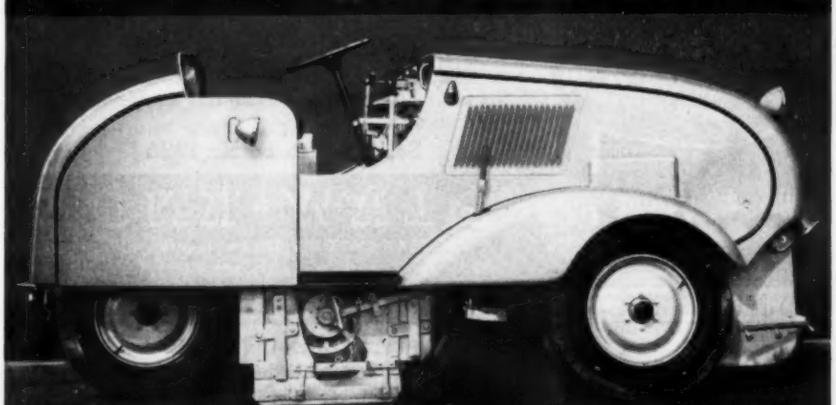
Union Fork & Hoe Co. Buy Rome Grader Corp.

The business of the Rome Grader and Machinery Corporation, 1212 East Dominick St., Rome, N. Y., has been sold to The Union Fork & Hoe Co. of Columbus, O. Rome Graders and allied lines will still be manufactured at the same location and the present personnel will be retained. The new division will be known as the Rome Grader and Machinery Division of The Union Fork & Hoe Co. The new owners hope to carry on the business in a larger way than has heretofore been possible, and to provide for that purpose new facilities in the way of additional machine tools and other improvements.

New Distributors for Hercules Co.

The Hercules Co., Marion, O., has appointed the following distributors for the Hercules Ironeroller: Scranton Tractor & Equipment Co., 1232 Penn Ave., Scranton, Penn., for 8 northeastern counties in Pennsylvania. Tractor & Equipment Co., Sidney, Mont., in eastern counties of Montana, and Karcher-Wolter Foley Co., 300 Wichita St., Wichita, Kan., for southeastern counties of Kansas.

South Bend GUTTER-SNIPE



-on the job

WITH DEPENDABLE

Red Seal POWER

The Gutter-Snipe is equipped with the Continental Y-112, 4-cylinder engine for fast, hard sweeping.

A Clean Sweep

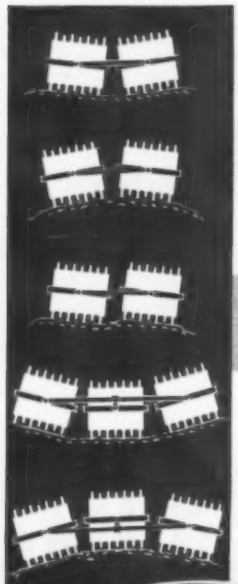
for those progressive cities and communities that want dirt-free streets and gutters.

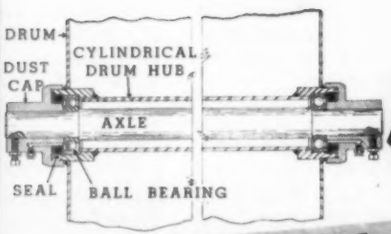
The South Bend Gutter-Snipe is compact — short — narrow — fast — rugged — economical. It sweeps a 5½ foot path. It picks up dirt and refuse.

Its dependable Continental Engine is sturdy, powerful and always on the job.

Continental Motors Corporation

MUSKEGON, MICHIGAN





AN EXCLUSIVE FEATURE

BLAW-KNOX *Oscillating Type*
TAMPING ROLLERS

- Illustrated above is the *through drum shaft —with sealed bearings*, an exclusive feature which means better performance and longer life from Blaw-Knox TAMPING ROLLERS.

Blaw-Knox pioneered the Tamping Roller for compacting earth fills—introduced the *double acting spring hitch* to absorb shocks, the feature of *easily renewable tamping feet.*

Blaw-Knox Tamping Rollers are designed interchangeably so that they can be used single, double, three abreast, double roller in front and single roller behind, etc. They are sturdily built for long life under hard service conditions.

The roller drums are free to oscillate to conform to all ground contours

Send for Catalog No. 1736

32

BLAW-KNOX

BLAW-KNOX DIVISION of Blaw-Knox Co.
FARMERS BANK BLDG., PITTSBURGH, PA.

BLAW-KNOX BINS AND BATCHERS • ROAD FORMS • STREET FORMS • CONCRETE SPREADERS • TAMPING ROLLERS • VIBRATORS
CONCRETE BUCKETS • CLAMSHELL BUCKETS • TRUCK MIXERS • STRIPING MACHINES • TURNTABLES • ROAD FINISHERS • STEEL FORMS

THE BURCH WAY

The BURCH DRAWN TYPE ROAD MAINTAINER will do a perfect job on dirt, cinder or gravel roads and, it's economical because it can be used with the power you now own.

It is a seven blade machine that handles the material four times, thoroughly mixing it before it is distributed over the road. The rear or finishing blade is reversible which permits the material to be moved to the right or left as desired.

Three hydraulic rams are used to lift the blades and to adjust the machine. These can be operated with either hand or power hydraulic as may be ordered. The control valve is always within easy reach of the operator.

Write for catalog.

Manufactured by

THE BURCH CORPORATION
Crestline, Ohio

Builders of Equipment for Fifty Years

"Established in 1885"

For LOW COST LARGE PRODUCTION
you can depend on
GRUENDLER EQUIPMENT
(FREE—Write for our 16 page Catalog and Specifications)

Self Traveling Tractor
JAW CRUSHERS
Ideal for maintenance road work

JAW CRUSHERS
Bronze or Roller Bearing
Heavy armor plate steel or cast steel.
Heavy Duty Construction
Large capacity
Small power Requirements

Stationary or Portable
LIMESTONE CRUSHERS
Wide crushing range, crushes stone to 2½" minus down to agriculture dust.
Ideal for Farm to Market Road Work

Portable 2 In 1 Hammer Crushers

GRUENDLER
CRUSHER & PULVERIZER CO.
2921-29 N. Market St., St. Louis, Mo.

G. H. Ford Heads New Test and Proving Division of Marmon-Herrington

Announcement of the creation of a new Test and Proving Division has been made by the officials of the Marmon-Herrington Company of Indianapolis, Ind., makers of all-wheel-drive trucks, tractors and military vehicles. To head this newly created division the company has selected G. H. Ford, for many years chief timer at the Indianapolis Motor Speedway. Mr. Ford has timed practically all of the world's record speed trials conducted in this country. For the past eight years he has acted as A.A.A. Contest Board official and in co-operation with Charles Merz, the A.A.A. Zone Supervisor, has officiated at all of the tests, trials and speed runs under official A.A.A. sanction in the Indianapolis area. Mr. Ford was formerly the representative of the duPont Powder Co. as a demonstrator of fire arms and commercial explosives. From this experience he gained a knowledge most valuable at this time in the manufacture of projectile resisting units. He has just returned from a three weeks' period at the proving grounds of the War Department at Aberdeen, Md., where he made a study of the requirements of our War Department in the matter of armor plate used in the construction of armored cars and tanks of the type built by the Marmon-Herrington Company.

G. H. Ford

Osgood Appoints Karcher-Wolter-Foley Co. as Distributors

The Osgood Co., Marion, O., has appointed the Karcher-Wolter-Foley Co., 300 Wichita St., Wichita, Kan., as distributors of Osgood excavating and material handling machinery in the southeastern counties of the state of Kansas.

J. S. Main Appointed Distributor for Osgood

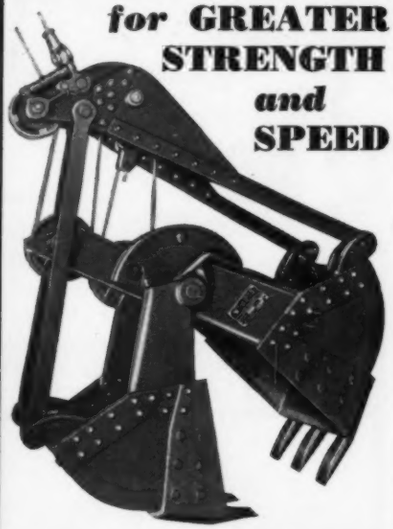
J. S. Main, well known equipment dealer in the state of Rhode Island, has been appointed distributor for the Osgood Co., Marion, O., manufacturers of excavating and material handling equipment. Mr. Main's headquarters will be in Seekonk, Mass.

Changes in Diamond Sales Organization

The Diamond Iron Works, Inc., has appointed William E. Wright as sales engineer for the company. Mr. Wright was formerly associated with the Austin-Western Co. and for the last three years has conducted an equipment business in Wisconsin. The company also announces the transfer of Frank P. Blancett, district representative, from the Southwest territory to the East Central territory. Mr. Blancett, prior to joining Diamond about a year ago, was engaged in the equipment business in Zanesville.

WELDED

ROLLED STEEL CONSTRUCTION for GREATER STRENGTH and SPEED



● The special welded construction formerly used only in custom-built buckets for extra heavy service in steel mill and dredging service is now featured throughout the entire Williams line. You'll do faster work—move more yardage with these Williams Buckets.

POWER ARM AND MULTIPLE ROPE TYPES FOR DIGGING AND MATERIAL REHANDLING
DRAGLINE-POWER WHEEL-DREDGING
STEEL MILL BUCKETS
⅜ YD. TO 16½ YD. CAPACITIES

Williams Buckets and Parts are carried by distributors in all parts of the country . . . Bulletin FREE on request.

THE WELLMAN ENGINEERING CO.
7003 Central Ave. • Cleveland, Ohio

WILLIAMS Buckets
built by WELLMAN

Link-Belt Speeder Corp. Appoints Horace Niles District Manager

Hayes Parsons, sales manager, Link-Belt Speeder Corporation, shovel-dragline-crane manufacturer, 301 West Pershing Road, Chicago, anounces the appointment of Horace L. Niles as district manager for the Pacific Northwest. For the past several years Mr. Niles has represented another well-known shovel manufacturer in the same territory. In order to become better acquainted with the organization, the company's policies and products, Mr. Niles recently spent two weeks at the Cedar Rapids and Chicago plants of Link-Belt Speeder Corporation. He is now back in the territory, and will make his headquarters at Howard-Cooper Corporation, East Third and Hawthorne, Portland, Ore.

Southern Equipment & Tractor to Handle Osgood Equipment

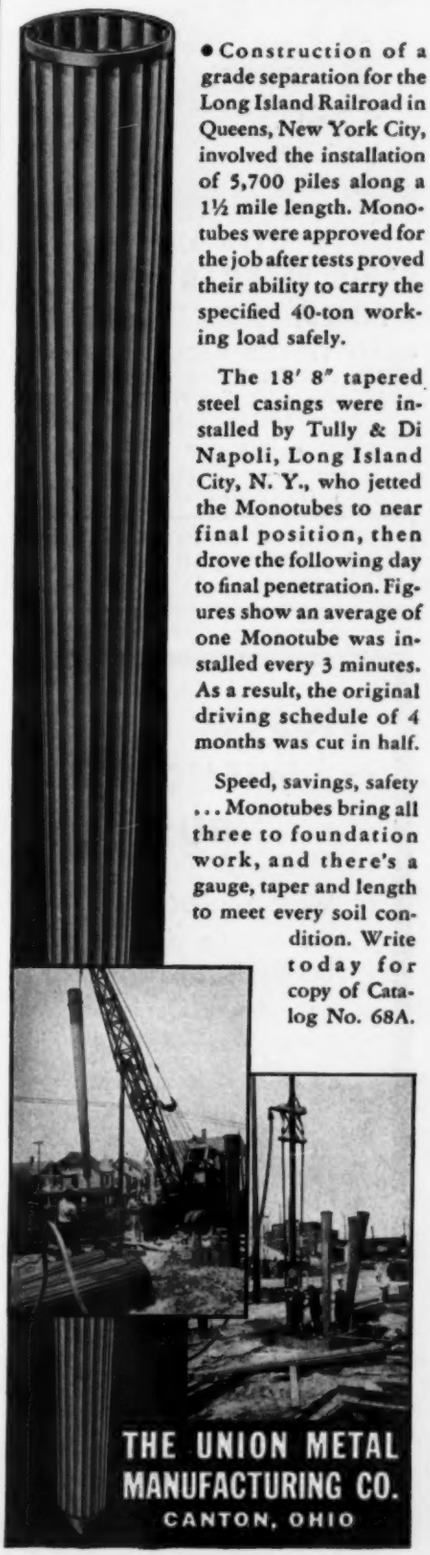
The Osgood Co., Marion, O., has announced that the Southern Equipment & Tractor Co., of Monroe, La., will handle their line of excavating and material-handling machinery, including the new Osgood Mobil-Crane, for the northern portion of the state of Louisiana.

NEW TRADE LITERATURE

Creosoted Laminated Culverts.—Prefabricated culverts which can be erected by unskilled field labor and which withstand loads in excess of 20,000 lb. are described in the booklet "Pressure-Creosoted Laminex Culverts" (Form G-16) published by Koppers Company, Wood Preserving Division, Pittsburgh. These culverts are made of laminated, pressure-creosoted wood, with sections interlocking cornerwise and lengthwise to form a solid, unified construction. Drawings and photos show how they are assembled. A table lists sizes obtainable. Details of the lumber and the preservative treatment used are given.

Pumping Concrete.—A catalog on the Rex Pumpcrete has just been issued. It describes the 1941 Pumpcrete models which are now equipped with a 3-way selective drive on the double cylinder models. This drive enables the operator to pump concrete through both cylinders simultaneously to gain full pumping capacity or to shut down either side of the pump without interfering with the continuous flow of concrete from the other cylinder. On pours where two points are being placed simultaneously, the 3-way selective drive allows the operator to slow up the flow of concrete in either pipeline to regulate the rate of pour. The new catalog includes information on pipeline handling, informative data on the types of jobs Pumpcrete is especially adapted to and complete specifications and dimensions for the machines themselves. Copy of the catalog can be obtained from ROADS AND STREETS by referring to.....RS130

MONOTUBES
CUT DRIVING SCHEDULE FROM 4 TO 2 MONTHS



● Construction of a grade separation for the Long Island Railroad in Queens, New York City, involved the installation of 5,700 piles along a 1½ mile length. Monotubes were approved for the job after tests proved their ability to carry the specified 40-ton working load safely.

The 18′ 8″ tapered steel casings were installed by Tully & Di Napoli, Long Island City, N. Y., who jetted the Monotubes to near final position, then drove the following day to final penetration. Figures show an average of one Monotube was installed every 3 minutes. As a result, the original driving schedule of 4 months was cut in half.

Speed, savings, safety ... Monotubes bring all three to foundation work, and there's a gauge, taper and length to meet every soil condition. Write today for copy of Catalog No. 68A.

THE UNION METAL MANUFACTURING CO.
CANTON, OHIO

BREAK-UP FROSTED GROUND!

WITH THIS

RAPID PAVEMENT BREAKER

FASTEST PNEUMATIC CONTROLLED MACHINE

BREAKS FROSTED GROUND, CONCRETE ROADS, BRIDGE DECKS AND TRENCHES. ADAPTABLE FOR TAMPING AND POST HOLE DIGGING

NOT A DROP WEIGHT

USED EXTENSIVELY ON STATE AND GOVERNMENT PROJECTS

CONCRETE CUTTING CORP. OF AMERICA
607 Degraw St. BROOKLYN, N. Y.

HUSTLE WITHOUT BUSTLE

We're hustlers when the occasion demands but we don't make any noise about it. Our service is as cheerful and quiet as it is speedy.

Emil Eitel
Karl Eitel
Otto K. Eitel

BISMARCK HOTEL-CHICAGO
RANDOLPH AND LA SALLE

Corrugated Metal Culverts.—A new catalog on its Penco corrugated metal culverts has been issued by the Penn Metal Corp., Oregon Ave. and Swanson St., Philadelphia, Pa. These pipes which are made from Normandy iron or Hampton steel, are illustrated and described in the catalog. Tables of standard sizes and recommended gauges and gauges and lengths are given. In addition some useful information on carry load and water carrying capacity of culverts is given.

Portable Air Compressors. — Bulletin C-40 issued by the O K Clutch and Machinery Co., Columbia, Pa., is devoted to its line of portable air compressors. The types of compressors are illustrated and described. In addition specifications are given for single and two stage compressors and for gasoline driven and diesel engine driven compressors. Details of construction are illustrated and described and several pages are given to illustrations and description of applications of the portable compressors on construction jobs.

Pneumatic Tools—Eight new pneumatic tools are featured in the Thor No. 52 Pneumatic Tool Catalog of Independent Pneumatic Tool Co. The catalog is fully illustrated by tool and action pictures and gives complete specifications on the entire line of Thor pneumatic tools and accessories, including:—Rotary and piston air drills; close corner drills; wood boring machines; wrenches and heavy tube rollers; rotary brushes; grinders; nut setters; screw drivers and tappers; core and rivet busters; chipping, riveting, scaling and staybolt hammers; balancers; motor hoists; holders-on; bench and floor rammers; rivet sets; rivet squeezers; sanders and saws; grinding, sanding, riveting and other accessories. Copy of the catalog may be obtained by writing ROADS AND STREETS.

Automotive Rings—Types of automobile piston rings used to restore performance in cars with various cylinder wear conditions are explained in a leaflet published (Jan. 14, 1941) by Koppers Company, American Hammered Piston Ring Division, Pittsburgh, Penn. Different combinations of specialized compression and oil rings are recommended for varying degrees of cylinder wear, with and without the operation of a (Koetherizer) machine re-boring the cylinders. Illustrated, too, is that corrects piston slap by resizing pistons to their original diameter.

New Excavator.—A new large-capacity excavator, the P&H Model 955, is described in a 30-page booklet issued by the manufacturers, the Harnischfeger Corporation of Milwaukee. The standard Model 955 is available as a 2½-yd. shovel, a 3-yd. dragline, a 3-yd. clamshell, or a crawler crane. There is also a long-range model capable of handling a 3-yd. dragline bucket on a 110-ft. boom, or a 4-yd. clamshell bucket. This model is equipped with extra-long crawlers and wide shoes for maximum stability and low ground pressure. Details of the machine and of its mechanism are described and illustrated in Bulletin X-21-1, copies of which may be obtained by addressing the Harnischfeger Corporation, Milwaukee, Wis.

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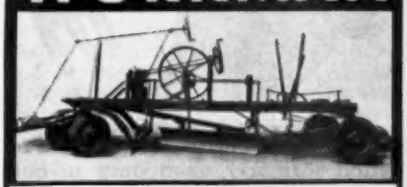

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